Draft

Phase 2 Focused Remedial Investigation

Sampling and Analysis Plan Addendum 1

for the

Diamond Head Oil Superfund Site Kearny, New Jersey

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DRAFT
SAMPLING AND ANALYSIS PLAN
Addendum 1

for
THE DIAMOND HEAD OIL SUPERFUND SITE

Kearny, Hudson County, New Jersey, 07032-4310

August, 2007

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INTRODUCTION

A complete Sampling and Analysis Plan (SAP) was prepared for the Diamond Head Oil Superfund Site (the Site) and approved by USEPA at the beginning of the Phase 1 Remedial Investigation in April 2003. A focused Phase 2 Remedial Investigation is currently planned at the site to collect information in support of the selection of an Interim Remedial Measure (IRM) for the Light Non-aqueous Phase Liquid (LNAPL) at the Site. Applicable sections from the 2003 Sampling and Analysis Plan will be adopted for the Phase 2 activities. This Addendum No. 1 incorporates by reference all sections, including Attachments from the 2003 SAP. In addition, this Addendum No. 1 describes the activities to be performed during Phase 2 and the procedures that must be followed to complete these activities. Only sections and Attachments from the 2003 SAP which require revisions for the Phase 2 activities are included in this addendum. New Standard Operating Procedures (SOPs) are also included for Phase 2 activities which were not part of Phase 1 and therefore, did not have SOPs. This SAP Addendum 1 is also complemented by the newly prepared Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP).

4.0 REMEDIAL INVESTIGATION ACTIVITIES

4.1 OVERVIEW OF RI ACTIVITIES

This section provides an overview of the field investigation and sampling operations by matrix and type of procedures. The field investigation will consist of the following tasks:

- Evaluation of historic aerial photographs and determination of locations for landfill investigation trenches
- Determination of the locations requiring temporary road construction to allow access to investigation areas respective to delineated wetlands
- Mobilization and demobilization of field facilities and equipment
- Construction of temporary roadways
- Vegetation clearance
- Landfill evaluation – trench excavations
- Laser Induced Fluorescence (LIF) Survey and associated soil and LNAPL sampling to delineate the extent of the LNAPL source area
- LNAPL recovery pilot test
- Air / Bio sparge pilot test
- Geophysical investigation for utility delineation at off-site locations
- Surveying
- Water and LNAPL level measurements
- Investigation derived waste (IDW) management and disposal
- Decontamination

The Site Management Plan in Attachment A details how the Phase 2 RI activities will be managed (e.g., site access and security, temporary facilities, management of RI-derived wastes, etc.).

The sampling program described in this section will be conducted in accordance with established Standard Operating Procedures (SOPs). These are provided in Attachment B. Attachment C contains the Heath and Safety Plan, which will be followed during the RI activities. The Health and Safety Plan was revised to incorporate the results (exposure concentrations) from the Phase 1 RI as well as health and safety considerations specific to the Phase 2 activities.

Table 1 summarizes the Phase 2 RI activities. These will be implemented in the following general sequence:

- Vegetation clearance and road construction
- Mobilize field facilities
- 1st water level / product thickness measurement event
- Preliminary screening of pumps and existing wells for LNAPL recoverability testing
- Landfill investigation
- Installation of Air/Bio sparge trench
- Subsurface geophysical survey for utilities in clover-leaf areas
- LIF investigation – onsite and off-site
- 2nd water level / product thickness measurement event
- LNAPL recoverability pilot test
- Air/Bio Sparge pilot test
- IDW disposal
- Demobilization of field facilities
- *Surveying to be performed throughout the activities*

Table 1 Summary of Focused Phase 2 Remedial Investigation Activities
Diamond Head Oil Superfund Site, Kearny NJ

Investigation Task	Sample / Data Type	Number of Locations	Type of Sampling Location	Location Designation	Location Selection Rationale	Samples per Location	Depth	Analyses	Turn-around Time	Lab or Field Observations	Sample Nomenclature	Example	Validation Requirments	QA/QC Sample Requirements	QA/QC Sample Designation
LIF Investigation	LIF	3	LNAPL LIF Calibration	N/A	LNAPL obtained from 3 existing wells for site specific calibration of LIF, (MW-03S, MW-13S, PZ-10)	1	LNAPL / Water interface	LNAPL jar Sample for field calibration of LIF equipment (MW-03S, MW-13S, PZ-10)	Real Time	Field	NA	NA	Field Calibration	NA	NA
	LIF	5	Site LIF Reference Probes	LIF-CAL-(location)	Initial LIF borings installed as site specific reference probes at locations with known site conditions	1	Match Phase 1 boring depth	Site specific reference probes to correlate LIF responses	Real Time	Field	NA	LIF-CAL-MW-03S; LIF-CAL-MW-13S; LIF-CAL-PZ-10; LIF-CAL-SB-27; LIF-CAL-SB-29	Field Calibration	NA	NA
	LIF	124 estimated	LIF boring	LIF-001 to LIF-124	Field decisions based on LIF results at previous locations	NA	NA	Field continuous logging	Real time	Field	NA	NA	Field calibration	NA	NA
	Soil Core Visual	3 from parallel runs to 3 of the 124 LIF locations	Soil Core Visual	LIF-(three digit number)	Soil core to visually correlate LIF log and soil conditions at High, Medium, and Low LIF Response Areas	1	To be determined	Visual observation Logging PID screening	Real time	Field	LIF-(sequential 3 digit number)-(depth range)-2	LIF-100-10-12-2	None	NA	NA
	Intact Soil Core	3 From parallel runs to 3 of the 124 LIF locations	Intact Soil Core	LIF-(three digit number)	High LNAPL Saturation (5-foot core) Medium LNAPL Saturation (4-foot core) Low LNAPL Saturation (3-foot core)	1	To be determined	<u>Pore Fluid Saturation:</u> (every six inches of core) LNAPL and water saturation[%], Total porosity, Air-filled porosity, Dry bulk density, Grain density <u>Core Photography</u> Drainage Capillary Pressure Test (one per core) {at maximum LNAPL saturation} Free Product Mobility (centrifuge method) (three pressure setpoints, two samples per core) Grain size analysis (two per core) Total organic carbon (two per core)	Standard	Specialty subcontracted lab	LIF-(sequential 3 digit number)-(depth range)-2	LIF-024-5-7-2 for the 1st sample at LIF location 24 from 5-7 ft of the core LIF-024-10-12-2 for the second sample at LIF location 24 from 10-12 ft of the core	None	NA	NA
	Soil Sample	4	Soil Core sample	SB-39 to SB-42	Near PZ-2, PZ-10, MW-13D, MW-14S based on historic results; locations need to be adjusted in the field if LIF data suggests that there is no LNAPL contamination in these areas	1	PZ-2 @ 15'-17', PZ-10 @ 5'-6', MW-13D @ 5'-6', MW-14S @ 7'-8'	SPLP for VOCs and SVOCs	Standard	Specialty lab	SB-(2 digit sequential number starting at 39)-(top depth-bottom depth)-2	SB-39-15-17-2 SB-40-05-06-2 SB-41-05-06-2 SB-42-07-08-2	None	NA	NA
	LNAPL + water samples	2	2 monitoring well locations	MW-03S; MW-13S	MW-03S in the heart of the LNAPL and MW-13S in the NE leg of LNAPL	2 - One of LNAPL and one of the groundwater beneath the LNAPL	LNAPL / Water interface	LNAPL Fluid Properties: (per LNAPL/water sample pair) Dynamic viscosity, Fluid density at three temperatures, Surface tension for each fluid, Interfacial tension (three phase pairs: oil/water, oil/air, water/air)	Standard	Specialty subcontracted lab	FP-(well or piezometer location)-2	FP-MW-03S-2 FP-MW-13S-2	None	NA	NA
	LNAPL thickness measurements	5	New temporary piezometers	TPZ-01 to TPZ-05	Based on LIF results in high, medium, and low response areas	NA	NA	LNAPL thickness and Water level measurements	Real time	Field	NA	NA	NA	NA	NA
LNAPL Recovery Test	LNAPL	1	Existing MW-03S	MW-03S	One sample will be collected from MW-03S where highest LNAPL thickness is measured	1	NA	TCL-full and TAL metals	Standard	DESA or subcontracted lab	FP-(well loccation)-2	FP-MW-03S-2	None	Equipment blank, Trip blank	E-2-(Month-Date-2 digit year)-(2 digit sequential # of QC sample that day); T-2-(Month-Date-2 digit year)-(2 digit sequential # of QC sample that day);

Table 1 Summary of Focused Phase 2 Remedial Investigation Activities
Diamond Head Oil Superfund Site, Kearny NJ

Investigation Task	Sample / Data Type	Number of Locations	Type of Sampling Location	Location Designation	Location Selection Rationale	Samples per Location	Depth	Analyses	Turn-around Time	Lab or Field Observations	Sample Nomenclature	Example	Validation Requirments	QA/QC Sample Requirements	QA/QC Sample Designation
Air/bio sparge	Groundwater	5	New temporary piezometers	TPZ-06 to TPZ-10	Piezometers will be located so that a network of monitoring points is created around the sparge trench. Wells will be spaced between 5-ft to 50-ft from the trench, on both sides of the trench. Final locations selected based on field conditions.	One before start of test One after end of test	NA	TCL-VOCs Heterotrophic count	3-5 days	CLP for TCL-VOC DESA or Subcontracted lab for bacterial	(Piezometer location)-(1 for sample before start of test or 2 for sample after the end of test)-2	TPZ-06-1-2 TPZ-06-2-2	None	Equipment blank, Trip blank (none for bacterial)	E-2-(Month-Date-2 digit year)-(2 digit sequential # of QC sample that day); T-2-(Month-Date-2 digit year)-(2 digit sequential # of QC sample that day);
Landfill investigation	Soil	2	Trenches (East and West)	LTR-E and LTR-W	Trench location based on historic aereal photographs, Samples evenly spaced over length of trench, OR biased to staining/odor	5	From fresh soil surface in excavator bucket	TCL-full TAL metals	Standard	CLP	(Trench designation)-(sequential 2 digit sample number along length)-2	LTR-E-01-2 LTR-W-01-2	Required	Duplicate, Equipment blank, Trip blank, MS/MSD	D-2-(Month-Date-2 digit year)-(2 digit sequential # of QC sample that day); E-2-(Month-Date-2 digit year)-(2 digit sequential # of QC sample that day); T-2-(Month-Date-2 digit year)-(2 digit sequential # of QC sample that day);
IDW	Decon water	1	Drum	WW	Select a representative drum, sample at same time as FP-IDW	1	NA	TCL-full TAL metals	3-5 days	CLP	WW-(sequential 2 digit sample number)-2	WW-01-2	None	NA	NA
	Decon water	1	Drum	WW	Select a representative drum, sample at same time as FP-IDW	1	NA	Haz waste characteristics (ignitability, corrosivity, reactivity)	3-5 days	DESA or subcontracted lab	WW-(sequential 2 digit sample number)-2	WW-01-2	None	NA	NA
	LNAPL IDW for disposal	1	Drum	FP-IDW	Select a representative drum; sample at same time as WW	1	NA	TCLP and haz waste characteristics (ignitability, corrosivity)	3-5 days	DESA or subcontracted lab	FP-IDW-(sequential 2 digit sampke number)-2	FP-IDW-01-2	None	NA	NA
Fire hydrant	Water	1	Tank used by landfill sub to transport water	FH	Water storage tank subcontractor uses to store/transport fire hydrant water	1	NA	TCL-full TAL metals	Standard	CLP	FH-(sequential 2 digit sample number)-2	FH-01-2	None	Trip blank	T-2-(Month-Date-07 or 08)-01

4.2 DETAILED DESCRIPTION OF RI ACTIVITIES

4.2.1 MOBILIZATION AND DEMOBILIZATION

The purpose of the mobilization is to familiarize field team members with the site setting and the planned field investigation activities and to assemble the required equipment and support facilities at the site. The mobilization effort will consist of activities such as logistical planning, identification and staking of sampling locations, equipment and field facilities mobilization to the site, and field personnel orientation and training. The orientation and training will familiarize the field personnel with the history of the site, the health and safety plan requirements, and the field investigation procedures. In addition, all field personnel will be responsible for familiarizing themselves with the Diamond Head Oil Site Phase 2 Focused RI/FS Work Plan, this SAP, including all attachments, and QAPP.

Equipment and facilities mobilization will entail the collection, ordering, purchasing, fabricating, transporting, and staging at the site of all sampling materials, equipment, supplies, facilities, and services needed to implement the field investigation. The following on-site facilities and services will be provided:

- Temporary road construction
- Vegetation clearance
- Field sanitary facility
- Field office and storage trailers
- Trash dumpster and trash removal services
- Temporary mobile electric generators for office trailer and Air/bio sparge equipment
- Broadband wireless internet service and printer/copier rental
- Field sampling equipment (consumables and rental)
- Decontamination pad for heavy equipment (e.g., drill rig, excavators)

The set-up of these facilities is described in the Site Management Plan in Attachment A. All field facilities, except for the decontamination pad, will be rented and their set-up at the site supervised by CH2M HILL staff. Subcontractors (the driller and construction subcontractors) will be responsible for setting-up the decontamination pad under CH2M HILL's supervision.

The purpose of the demobilization at the completion of the field activities is to remove field facilities, sampling equipment and supplies, and personnel from the site. Demobilization will also include containerizing, staging and inventory of investigation-derived wastes, which will remain on-site until properly disposed of; decontamination and demobilization of field equipment; demobilization of supplies, and organization of investigation records.

No analytical data will be collected during the mobilization/demobilization task.

4.2.2 VEGETATION CLEARANCE

A subcontractor will be procured to clear vegetation at the site which will involve a one-time cutting of phragmites and underbrush. Standing vegetation will be cut along two transects over the landfill area, each approximately 30 feet wide, to allow open access for trenching investigation activities. Additionally, general clearing of vegetation in the areas of the site that will be used for equipment and facilities will be performed. This is in general the area to the north and east of the landfill, including the berm along the east boundary of the property. The cut vegetation will be removed from the work areas and staged in inactive areas of the site in order to reduce tick exposure during field work.

No laboratory analytical data will be collected during these activities.

The following SOPs provided in Attachment B will be used to construct the temporary roads:

Standard Operating Procedures for Vegetation Clearance	
SOP Number	**SOP Topic**
26	Vegetation Clearance and Road Construction Documentation

4.2.3 CONSTRUCTION OF TEMPORARY ROADWAYS

Several dirt roads exist at the site. Areas of these dirt roads that are known to flood or degrade to soft mud with heavy vehicle traffic, must be improved to support the Phase 2 activities. New gravel roadways are also needed in certain areas. The roadways are planned to support general truck traffic of average GVW 52,000 pounds and will be installed only where needed.

A subcontractor will be procured to construct the roadways. Roadway improvements will consist of laying geotextile fabric and overlaying it with a thickness of 3- to 6-inches of a minimum of 2-inch diameter stone or dense grade aggregate (DGA) (crushed concrete will not be allowed). New roadway construction will consist of laying geotextile fabric and overlaying it with a thickness of 12- to 24-inches of rip-rap stone (4-12 inches diameter) followed by DGA to fill the void space (crushed concrete will not be allowed). Low-lying areas and depressions within the road right-of-way will require additional grading and stone fill to level before placing the geotextile fabric and covering it with stone. The roadway improvements are estimated to have a total length of 200 feet by 12 feet wide. The new roadways are estimated to have a total length of 960 feet by 12 feet wide (with one 40 foot by 40 foot turnaround). The roadway improvements / construction will include two access ramps to provide access to the landfill as well as access to the former lagoon area. The access ramps to the landfill are estimated to be approximately 50 feet in length. No excavation into the landfill will be required to prepare ramps.

At the end of this task, CH2M HILL will survey (using GPS) the center line of the roadways and prepare a site plan showing the layout with a photo log keyed to this site plan. Documentation of road construction activities is described in detail in the SOP.

No laboratory analytical data will be collected during these activities.

The following SOPs provided in Attachment B will be used to construct the temporary roads:

Standard Operating Procedures for Construction of Temporary Roadways	
SOP Number	**SOP Topic**
3	Field Logbook Procedures
4	Field Parameter Forms

Standard Operating Procedures for Construction of Temporary Roadways	
SOP Number	**SOP Topic**
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
9	Equipment Decontamination
26	Vegetation Clearance and Road Construction Documentation
28	Global Positioning System Survey Methods

4.2.4 LANDFILL EVALUATION – TRENCH EXCAVATION

The composition and contents of the landfill will be evaluated through visual observations and analytical data collection during the landfill evaluation activities. A subcontractor will be procured to excavate two linear trenches (i.e., continuous linear test pits) along the long axis of the landfill. Throughout the trenching activities, the spoils from the excavation will be observed, logged, and scanned with field instruments to document the contents and evaluate the presence of contamination. Soil samples will also be collected for laboratory analysis.

Excavation along the two trench paths is planned in small incremental segments (10-15 feet in length) to manage slope stability and prevent collapse. Prior to commencing excavation of each segment, erosion control measures such as hay bails or silt fencing perimeter will be positioned around the excavation area. As work progresses, dust accumulation in the air will be monitored and controlled with water trucks / sprinklers such that no visible dust clouds form in the work area. The source of the water will be from nearby fire hydrants.

Due to the unknown nature of the landfill contents, the trenching program will be a dynamic process that adapts to encountered field conditions. Trenching will begin at one of the landfill edges to attempt to establish the depth of the native soil and the depth of groundwater. The trenches within the footprint of the landfill will likely be of varying depth due to the irregular shape of the landfill and the nature of the landfill's contents. The trenches will target the full thickness of the landfill or to the groundwater table, whichever is encountered first. Based on the water levels measured in monitoring wells at the site, the depth to the water table in the landfill is expected to be at approximately 10 feet below the top of the landfill. Therefore, the test trenches will be attempted to a depth of 10 feet or will terminate at the water table if it is encountered shallower than 10-feet. Slope stability and field conditions will also be used in determining the final trench depth. Based on these, the trenches may need to be terminated at shallower depths dictated by the encountered conditions. If large debris that is impassable with reasonable effort is encountered in the intended path of the excavation, the excavation will be abandoned at that location and resumed as close as practicable to this location further along the intended path of the excavation.

The width of the trenches at the base will be approximately 2.5 feet (the bucket-width of an excavator) but may be expanded based on encountered conditions for the stability and safety of the excavation. Excavation will be performed in a manner that will not require benching, sloping (1:1) or shoring of the excavation walls because of the nature of the materials into which the excavation will proceed (i.e., debris of irregular size and shape). Workers will not enter the trench.

Excavated spoils will be logged and soil samples will be collected from the spoils. The presence of fill, debris, natural material, wastes, and contamination will be noted (for example, stained soils will be noted and documented). A log to record observations during trenching will be utilized along with a photo log. The documentation that will be collected is described in the landfill trenching SOP.

An exclusion zone will be maintained around the excavation. Excavated materials will be temporarily staged close to the excavation but maintaining a minimum distance to prevent collapse and meet OSHA regulations. Following logging, materials will be returned back into the excavation and compacted with the excavator bucket. Work will be scheduled such that sections of the trench will be excavated and backfilled in the same day so that no excavations are left open overnight.

If drums are encountered, the excavation will be stopped and EPA contacted for direction. While waiting for direction and in order to minimize the amount of subcontractor downtime charges, the excavation equipment (*Landfill Trenching and Documentation of Landfill Materials* SOP) will be moved along the intended path (e.g., 20 feet away) and digging will resume. While remediation of buried drums is not the intent of this investigation, any drums that are incidentally removed from the subsurface or ruptured will be overpacked for disposal. The overpacked drums will be temporarily staged at the site until a direction for path forward is determined.

Intrusive subsurface activities, such as test pitting, in historic undocumented, uncontrolled disposal areas present a higher than normal risk compared to similar activities at documented/permitted disposal sites. To help mitigate the risks, a subcontractor with emergency response capabilities will be selected. The subcontractor will maintain an emergency response trailer and supplies at the site throughout the duration of the landfill investigation. In the event that unclassified contamination is encountered (e.g. buried drums), sufficient PPE, respiratory protection, and materials (e.g. sorbent materials, overpack salvage drums, etc.) will be available to mitigate a localized spill or release of contaminants.

Although historic information suggests that the landfill is comprised of construction debris, methane (CH_4) and hydrogen sulfide (H_2S) may be an issue, particularly in the geologic setting of the area (meadowmat). Health and safety monitoring will include monitoring for methane and hydrogen sulfide and non-sparking, grounded equipment with rubber tires will be used to manage the potential for sparks and associated fire.

Five soil samples will be collected from each trench path (total of 10 samples plus associated quality control samples). The samples will be spaced equally over the length of each excavation path or biased to excavated soil observed to be stained. The planned sampling locations will be selected at the time the layout of the trench is staked before beginning excavation activities.

All soil samples from the landfill evaluation will be analyzed for TCL VOCs, TCL semi-VOCs, TCL pesticides/PCBs and TAL metals. The samples will be analyzed through EPA's CLP and the results will be validated to allow use in risk assessment.

Because the excavations will not be entered by field staff due to safety considerations, the soil samples will be collected from the excavator bucket. A discrete section of soil contained within the bucket will be selected for sampling, brushing aside soil at the surface of the bucket to obtain a fresh sample form within the soil mass. The sample for VOC analysis will be collected first, directly out of the excavator bucket, using En Core® Samplers. The remaining soil from the selected sample interval will be placed in a stainless steel mixing bowl and will be thoroughly homogenized. The soil will then be placed into additional soil sample jars for analyses for non-VOC organic compounds and metals. Additional sample jars will be filled for the QC samples.

Thus, the samples collected for laboratory VOC analyses are considered discrete samples while the samples collected for the remaining laboratory analyzes are considered composite samples. The soil sampling procedures are described in detail in the SOPs in Attachment B.

During the excavation activities, CH2M HILL will survey (using GPS) the boundaries of each excavation segment. Photographs taken of each segment will be keyed to the survey log of the segment locations and correlated with the test pit observations log for that segment. At the end of the task, CH2M HILL will also survey the center line of the trenches and prepare a site plan showing the layout of the trenches including the individual trench segments. . CH2M HILL will then assemble a summary of the chronology of field activities and types of materials encountered in each segment based on the daily trenching logs and the photographic log.

The field screening of the excavation spoils will generate screening type data. The soil samples analyzed for TCL organics and TAL metals will generate definitive type data.

The following SOPs provided in Attachment B will be used to perform this investigation:

Standard Operating Procedures for Landfill Evaluation – Trench Excavation	
SOP Number	**SOP Topic**
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures
4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
9	Equipment Decontamination
17	Collection and Preservation of Soil Samples for VOC
27	Landfill Trenching and Documentation of Landfill Materials
28	Global Positioning System Survey Methods
30	Sampling of Soil During Landfill Trenching

4.2.5 LASER INDUCED FLUORESCENCE (LIF) SURVEY

Objectives

The specific objectives of this investigation are to:

- Delineate the lateral and vertical extent of LNAPL including residual and potentially mobile phases
- Estimate the extent of LNAPL that exceeds leachability to groundwater criteria using SPLP analysis
- Estimate the extent of potentially mobile LNAPL
- Estimate the order-of-magnitude mobility (i.e., pore fluid velocity) and recoverability of LNAPL at three diverse locations at the site including areas of high, medium, and low LIF response

Each of these objectives will be met through completion of the tasks described in this section.

Description of Laser Induced Fluorescence Technology:

Laser induced fluorescence (LIF) technology will be used to delineate the extent of the LNAPL at the site and continuing off-property until delineation is achieved. The investigation will begin onsite in the former lagoon area and former refinery area and will extend into the Rt. 280 cloverleaf as necessary.

LIF is a laser-based technology that utilizes light-energy in the form of a laser to energize and excite hydrocarbon-based chemicals causing them to fluoresce and emit light. The laser causes hydrocarbons to fluoresce and emit a characteristic spectrum (multiple wavelengths) of light which is detected by the probe tip optical assembly.

LIF technology is introduced into the subsurface through the use of a conventional direct push technology (DPT) or cone penetrometer technology (CPT) drill rig outfitted with standard hollow steel drill rods and a specially designed LIF probe point that houses an optical assembly for the laser. A laser generator and control box are housed on-board the drill rig at ground surface and laser light is transmitted down the hollow drill rod to the optical assembly probe point through flexible fiber optic cables. A very fast (10 nanosecond) pulse of laser light is emitted from the optical assembly into the adjacent soil. If hydrocarbons are present in the soil, the energy from the laser is absorbed by the contaminants and returned as fluorescent light at a characteristic spectrum of wavelengths. The fluorescent light is captured by the optical assembly in the probe tip and is reflected by mirrors back to the ground surface through the fiber optic cables. A spectrometer and oscilloscope housed on the drill rig evaluate the reflected fluorescent light and transmit a graphical "waveform" describing the characteristics of the fluorescent light to a computer. The intensity of the fluorescence at four different wavelengths is compared against a pre-calibrated reference emitter and a strip log of the LIF relative response is produced. The entire process occurs virtually instantly (under 20 nanoseconds) allowing for continuous, real time evaluation of the subsurface at the same rate at which drill rods are advanced.

The LIF tool is employed is an in-situ evaluation system that provides real-time, semi-quantitative graphical data. Conventional soil core samples are not collected during routine LIF implementation, but are typically collected following the LIF survey from immediately adjacent drilling locations using the DPT drill with conventional tooling.

The LIF technology generates a color-coded, scaled graphical log for each boring location. The vertical axis of the graph corresponds to depth below ground surface, and the horizontal axis quantifies the relative fluorescence of contamination observed in the soil as referenced to a standardized source. The data are presented as a percent of the reference emitter unit (% RE).

LIF reflectance data will be plotted using a 3D visualization package to show the vertical and horizontal extent of LNAPL and the relative LNAPL saturation in these areas. A dynamic, observational, and adaptive approach will be used to optimize the number of LIF measurements and achieve the data objectives in a cost-effective manner. This approach will entail daily review of the LIF results and adjustment of future LIF locations to achieve the necessary delineation. For instance, LIF locations would not progress beyond a location with low responses that indicate the lack of LNAPL. In addition, several of the LIF locations will be installed close to piezometer locations where in-well LNAPL has been observed and data on chemical constituents in soil are available from the Phase 1 investigation. This will allow for the LIF results to be compared with the Phase 1 chemical constituent results, and if possible, a correlation can be made between them.

Implementation

Table 1 provides an overall summary of the LIF program and Figure 2 shows the LIF delineation areas. The text and tables included below in this section provide supplemental detail.

LIF equipment and direct push drilling equipment will be mobilized to the site. The first activity in the field will be to set-up, test and baseline the LIF equipment. Testing and base-lining will be performed through a series of above-ground and *in situ* tests. The fluorescence and relative response of the LIF probe will be tested with standards provided by the subcontractor as well as by using a jar sample of LNAPL from three existing monitoring wells at the site (e.g., MW-3, PZ-8 and PZ-10). Base-lining of *in situ* fluorescence response will be performed by advancing the probe in three areas known to contain LNAPL (e.g., adjacent to wells MW-3, PZ-8 and PZ-10 from which LNAPL samples were obtained) and two areas of "clean" soil toward the north end of the site near Phase 1 borings SB-03 and SB-05. The LIF response log will be compared to historic soil boring logs and analytical data collected during the Phase I Investigation.

Delineation of the extent of LNAPL at the site will begin in the vicinity of the former "oil lake" as documented in historic aerial photographs. Figure 2 shows the general areas for the LIF investigation and an overlay of the former oil lake based on the aerial photography. The 4.3 acre (190,000 sq. ft.) area bounded by the former refinery area / landfill / Wetland Area 4 (MW-3 area) / and the I-280 entrance ramp soil berm will be the focus of the initial delineation activities.

Initially, the LIF probe will be advanced to a depth of approximately 12 feet below ground surface, which roughly corresponds to a depth of 10 feet below water table. The actual depth of advance, however, will correspond to a depth of at least two feet below the LNAPL. LIF probing <u>will not</u> continue through the peat layer to avoid compromising this stratigraphic unit. The delineation probing will commence on a grid system with probing at 50-foot center points. Actual probe spacing, location, terminal depths and delineation will be determined in the field using a dynamic and adaptive process during implementation based on observed results. The delineation probing will continue until an area of "low" response is encountered (as compared to the baseline response) indicating that delineation has been achieved. Based on the size of the initial probing area, 76 borings are estimated to be advanced corresponding to 912 linear feet (l.f.) of probing.

Sampling Locations

Based on historic aerial photography, it is assumed that delineation will continue to the east beyond the Diamond Head fence line and into the adjacent property owned by NJDOT. Attempts will be made to mobilize the drill rig to the top of the 20-foot high soil berm bordering the highway entrance ramp so that delineation can continue uninterrupted through this area. If unsuccessful, delineation will have to resume further east beyond the highway drainage culvert and paved access ramp roadway (within the clover leaf area). Probing on top of the soil berm will be performed on 50-foot centers and is estimated to be advanced to an average depth of 32 feet (through 20-foot of berm + 12-foot below grade). The section of the berm north of the cross-cutting drainage swale that empties into the entrance ramp drainage culvert is approximately 400 feet long and a maximum of 9 LIF probes would be advanced in this area corresponding to 288 l.f. of probing. The actual number and depth of LIF advancements, however, may vary based on the decision criteria specified above.

Additional delineation to the east will be performed in the cloverleaf area of the entrance ramp for I-280. Delineation will be performed in the grassy areas of the cloverleaf ramps away from the paved roadway areas. Based on historical aerial photography, three areas of the cloverleaf interchange will be targeted for delineation activities: the main cloverleaf triangle east of Diamond Head, an unwooded portion of the north cloverleaf triangle, and the east cloverleaf triangle. The main cloverleaf triangle is sufficiently sized to allow for continuation of the 50-foot center grid for delineation probing. This area is approximately 1 acre in size (46,200 sq. ft.) and would include 19 probe locations. The spacing of probe locations in the smaller cloverleaf areas will be less regular but selected to cover the area so that it can be adequately evaluated based on the observed results. It is estimated that 11 LIF borings will be installed in the 7,000 sq. ft. unwooded portion of the north cloverleaf triangle and 9 borings will be installed in the 5,400 sq. ft. area of the east cloverleaf triangle. Probes in the cloverleaf area are assumed to be installed to 12 feet below ground surface corresponding to a total of 468 l.f. of profiling. The actual number and depth of LIF advancements, however, may vary based on the decision criteria specified above. The table below summarizes the LIF program.

Table 2 LIF Program: Summary of Delineation Probing

Investigation Location	**Size of Area**	**Grid Spacing & Probing Depth**	**Number of Probe Locations ****	**Total Linear Footage of LIF**
Process Area / Landfill / Wetland Area 4 (MW-3 area) / I-280 berm	4.3 acres (190,000 sq. ft.)	50-foot centers 12 ft. bgs	76	912 l.f.
Top of Soil Berm (north end of berm)	400 ft. long 0.11 acre (4,800 sq. ft.)	50-foot centers 32 ft. bgs	9	288 l.f.
Main cloverleaf triangle	1 acre (46,200 sq. ft.)	50-foot centers 12 ft. bgs	19	228 l.f.
Unwooded portion of north cloverleaf triangle	0.16 acre (7,000 sq. ft)	50-foot centers 12 ft. bgs	11	132 l.f.
East cloverleaf triangle	0.12 acre (5,400 sq. ft)	50-foot centers 12 ft. bgs	9	108 l.f.
Totals:	5.7 acres 249,080 sq. ft.		124	1,668 l.f.

NOTE:
** The number of LIF probe locations will be based on observed results and surface infrastructure restrictions.

Sampling Criteria

Soil core samples will be collected for correlation with the LIF profiles. The cores will be advanced immediately adjacent to the LIF profile borehole and will be installed at 3 locations using the same direct push drill rig and using conventional MacroCore™ type samplers. Selection of locations for core observations will be based on the results observed in the LIF profile. One core will be collected in each of a high response, medium response and low response areas according to LIF results. The soil cores will be visually observed for indications of LNAPL, screened for VOCs with a photoionization device (PID), and logged for correlation with the LIF profiles. Soil samples will not be collected for conventional environmental analysis as sampling was performed during the Phase I Investigation and the objective of this effort is to delineate the extent of LNAPL.

Additional soil core samples will be collected and tested as described below to supplement the LIF survey and the LNAPL recovery pilot testing to fulfill the data objectives specified above. Each sample set described below is assumed to require a separate coring run with the drill rig.

<u>Temporary Piezometer Installation</u> – To fulfill the data objectives related to mobility and recoverability, up to five temporary 1-inch piezometers will be installed within areas of high, medium, and low LIF response to be used to estimate LNAPL recharge and recoverability. The locations will be strategically selected around the existing 12 piezometers surrounding well MW-3 and at varying distances to provide a network of monitoring points that can be used to assess LNAPL recovery influence.

Piezometers screens will span the entire thickness of the LNAPL smear zone. The temporary piezometers will be dropped into the boreholes and the native formation allowed to collapse around it upon extraction of the DPT casing. The wells will be allowed to set for an adequate amount of time for the LNAPL thickness to stabilize (daily/weekly measurements) and final thickness recorded and correlated to the local LIF response. Upon completion of the testing, the piezometers will be extracted and the boreholes properly abandoned.

<u>Intact Core Sampling</u> – A subcontracted laboratory will be used to perform these specialty tests.

Intact soil core samples will be collected from three locations throughout the extent of LNAPL, one each in an area of high LNAPL saturation, moderate LNAPL saturation, and low LNAPL saturation (e.g., next to a well/piezometer with only a sheen of product). Intact cores will be collected within an acetate MacroCore™ sleeve extending from a depth of 1 foot above the LNAPL smear in the vadose zone to 2 feet below the LNAPL smear in the saturated zone (estimated total of 5 feet of core at the high saturation location, 4 feet of core at the moderate saturation location, and 3 feet of core at the low saturation location). The acetate sleeves will not be cut open for observation but instead will immediately be packed, capped, and flash-frozen with dry ice to "lock" the pore fluids and soil grains and LNAPL in place and shipped overnight to a specialty lab for LNAPL mobility and recoverability evaluation. Only soil cores with greater than 75% recovery will be acceptable for shipment to the laboratory for analysis. If less recovery is achieved, the core will be re-attempted at an immediately adjacent boring. If adequate recovery is not achieved with two additional attempts, the location will be abandoned and sampling will progress to the next planned location.

The laboratory evaluation testing will be performed at locations selected by the laboratory technician using their discretion based on observations of the core. It will initially consist of core photography for core screening and sub-sample identification. It will be followed by Pore Fluid Saturation (PFS) analysis performed every six inches in the cores including LNAPL and water saturation [%], total porosity, air-filled porosity, dry bulk density, and grain density. Upon review of the PFS data, a Drainage Capillary Pressure Test will also be performed (one per core location at the interval containing the maximum LNAPL saturation). This test forms the basis of the mobility and recoverability analyses and will provide a sound basis for the remediation technology evaluation. Additionally, two Free Product Mobility (centrifuge method) tests will be performed on each of the three cores, one from the vadose zone and one from the saturated zone. This test applies three different pressures to simulate in situ conditions under which LNAPL may mobilize (ambient, remediation-induced, and maximum practical). The results of this test will be used to assess residual LNAPL saturation levels under various conditions in the vadose and saturated zones. Finally, two grain size distribution analyses and two total organic carbon (TOC) analyses will be performed per core sample.

<u>Synthetic Precipitation Leaching Procedure (SPLP)</u> – The SPLP is used as a surrogate for regulatory leachability criteria in that it simulates rainfall infiltration or groundwater contact for LNAPL that is submerged. It can be used to justify alternative LNAPL-contaminated soil cleanup levels using a risk-based approach to LNAPL cleanup. This is particularly applicable if leachability to groundwater is the primary exposure pathway as is suspected at Diamond Head. Highly weathered residual oil may be present in some areas of the LNAPL plume which may not be able to be removed and could be left in place because it no longer is releasing contaminants to groundwater. Four SPLP tests will be performed for VOC and SVOC analysis from soil cores collected from boring runs adjacent to existing wells/piezometers and from soil samples collected at the same depths as historic VOC analysis performed during the Phase I Investigation. The locations of these borings will be selected based on the Phase 1 results and finalized in the field based on the LIF results. This would allow comparison of the SPLP results to actual chemical concentrations in the soil. A specialty laboratory will be used to perform these tests. The data will not undergo validation as it will not be used in risk assessment.

<u>LNAPL / Groundwater Sampling</u> – In addition to the soil cores, a groundwater and LNAPL sample pair will be collected from two well locations around the LNAPL plume (preferably near the soil core locations). An LNAPL Fluid Properties Analysis package will be performed on each water/LNAPL sample pair. The results will be used in conjunction with the LNAPL mobility and recovery test results. This analysis includes dynamic viscosity, fluid density at three temperatures, surface tension for each fluid, and interfacial tension (three phase pairs; oil/water, oil/air, and water/air). A subcontracted laboratory will be used to perform these specialty tests.

The table below summarizes the associated LIF soil sampling.

Table 3 LIF Program: Summary of Sample Analysis

Sample Type	**Number of Sample Locations**	**Analysis Type & Frequency**	**Total number of Analysis to be Performed**
Temporary Piezometer Wells for LNAPL measurements	5 Locations: High, Medium, Low Response Areas	Periodic (e.g., daily) measurements of LNAPL thickness. Correlate thickness with LIF response	Daily measurements
LIF Correlation Cores	3 Locations: High, Medium, Low Response Areas	Visual observation Logging PID screening	3 sets of observations
Intact Core Sampling	<u>3 soil boring locations:</u> High LNAPL Saturation (5-foot core) Medium LNAPL	<u>Pore Fluid Saturation:</u> (every six inches of core) LNAPL and water saturation[%], Total porosity, Air-filled porosity, Dry bulk density, Grain density	24 of each analysis
		<u>Core Photography</u>	7 photos

Table 3 LIF Program: Summary of Sample Analysis			
	Saturation (4-foot core) Low LNAPL Saturation (3-foot core)		(assuming 2-foot photo segments)
		Drainage Capillary Pressure Test (one per core at locations selected by PTS lab based on observations and reported in the data package) {at maximum LNAPL saturation}	3 capillary pressure tests
		Free Product Mobility (centrifuge method) (three pressure set points, two samples per core at locations selected by PTS lab based on observations and reported in the data package)	18 tests
		Grain size analysis (two per core at locations selected by PTS lab based on observations and reported in the data package)	6 grain size tests
		Total organic carbon (two per core at locations selected by PTS lab based on observations and reported in the data package)	6 TOC tests
SPLP Leachability	4 soil boring locations: Adjacent to wells/piezometers and at depths selected based on the Phase 1 soil results and refined based on the LIF results	Synthetic Precipitation Leaching Procedure (SPLP) for VOC & SVOC analysis (one per core with depth selected based on Phase 1 soil results and refined based on the LIF results)	4 SPLP (VOC & SVOC)
LNAPL / Groundwater Samples	2 monitoring well locations: Near soil core locations	<u>LNAPL Fluid Properties</u> (per LNAPL/water sample pair) Dynamic viscosity, Fluid density at three temperatures, Surface tension for each fluid, Interfacial tension (three phase pairs: oil/water, oil/air, water/air)	2 of each analysis

At the end of this task and based on the results of the LIF evaluation, CH2M HILL will use 3-D visualization software to reduce the data and prepare plans and profiles showing the extent of LNAPL. The laboratory data will be used to estimate the zone of potentially mobile-LNAPL (as a subset of the LIF delineation) and tabulated and used to evaluate actual LNAPL saturation profiles in soil compared to in-well LNAPL thickness measurements and to estimate LNAPL relative permeability and pore velocity as a function of LNAPL saturation and LNAPL gradient. These data along with the estimation of the extent of potentially mobile LNAPL can then be used to estimate the LNAPL recoverability of various available LNAPL fluid recovery systems.

At the end of this task, CH2M HILL will survey (using GPS) the locations of all the points installed as part of this investigation. The data generated during the LIF investigation and associated sampling will be used to evaluate remedial alternatives and will not be utilized for risk analysis. It is therefore screening type data.

The following SOPs provided in Attachment B will be used to perform this investigation:

Standard Operating Procedures for Subsurface Soil Investigation	
SOP Number	**SOP Topic**
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures
4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
9	Equipment Decontamination
11	Borehole Abandonment
12	Monitoring Well and Piezometer Design and Construction
13	Monitoring Well and Piezometer Development
23	Laser Induced Fluorescence and Confirmatory Soil Sampling
28	Global Positioning System Survey Methods
29	Transit Level and Stadia Rod for Elevation Measurements
31	LNAPL Sampling During LNAPL Recovery and LIF Characterization

4.2.6 LNAPL RECOVERY PILOT TEST

An LNAPL recoverability test will be implemented to develop design criteria and assist in the evaluation of fluid recovery technologies that may be used to remove the mobile-LNAPL.

Objectives

The specific objectives of this investigation are to:

- Estimate the range of LNAPL transmissivity and recoverability present across areas of high, medium, and low LIF response and variable in-well LNAPL thicknesses
- Provide a second line of evidence (in addition to laboratory LNAPL mobility evaluation) for predicting LNAPL recovery rates from various fluid recovery technologies

Each of these objectives will be met through completion of the tasks described in this section.

It is anticipated that existing well MW-3 and the surrounding existing network of piezometers will be suitable for the LNAPL recoverability test. If after evaluating these wells during the mobilization phase of the investigation it is determined that they cannot be used or that a well or additional piezometers are needed, these will be installed for the test during the LIF investigation phase of work. If well(s) and piezometer(s) are determined to be needed, they will be of a design that can be used as part of full scale recovery system.

Implementation

This activity will begin with an LNAPL bail down pre-test to help assess the design specifications for equipment needed for the pilot tests. The pre-test will be performed early in the field investigation program and will commence with a baseline round of water level and LNAPL thickness measurements from MW-3 and the surrounding twelve piezometers. For the pre-test, LNAPL will be purged rapidly from MW-3 using bailers and a peristaltic pump and the recharge rate will be assessed through periodic water level / LNAPL thickness measurements. The information gathered during this pre-test will assess the suitability of well MW-3 and the surrounding piezometers for the test and help in designing the equipment specifications for the pilot test and in determining the anticipated duration of the tests. The pre-test will be accomplished in one day and the LNAPL purged from the well will be containerized in a 55-gallon drum.

The LNAPL recovery pilot test will include purging free product from a well (MW-3) and observing the rate of drawdown in adjacent monitoring locations, and the rate of product accumulation in the pumped well. The test will begin with baseline water level and LNAPL thickness measurements from MW-3 and the surrounding piezometers. To perform the test, a pumping system will be designed based on the pre-test results and will be utilized to purge free product from the well. In general, the pumping system will be operated such that floating free product LNAPL is removed from the well at a steady, continuous rate until all available free LNAPL is removed from the well. The pump will be shut-off to minimize the amount of water removed from the well (ideally no water is removed) and LNAPL will be allowed to recharge into the well before pumping resumes. LNAPL thickness and water levels will be monitored with an oil/water interface probe during the pumping test.

Four pressure transducers will be installed in select wells to monitor the rate of product and water accumulation in the wells. One transducer will be installed in the pumped well and three transducers will be installed in surrounding piezometers at different distances from the pumped well. Head readings will be collected at logarithmic intervals. In addition, manual water level / product thickness measurements will be gathered from the wells with transducers and the remaining piezometers using an oil/water interface probe. Manual measurements from the wells with transducers are needed to calibrate the transducer response in terms of depth to water and, LNAPL thickness.

A series of three tests will be performed at the pumping well. Product recovery measurements will be collected during each test until at least 80% of the original product thickness in the well has recovered or for up to 8-hours. Testing periods will be off-set by a day to allow for full recovery and the return of static conditions prior to initiating the next test. The subsequent test will not be initiated until at least 80% of the LNAPL thickness has recovered.

At the end of the test, a sample of the LNAPL will be collected directly from the well for characterization purposes. The sample will be analyzed for TCL VOCs, semi VOCs, pesticides, PCBs and TAL metals. The samples will be analyzed through EPA's DESA laboratory or a subcontracted laboratory. The data will not be used in risk assessment.

The recovered product will be containerized in 55-gallon drums and sampled for characterization for off-site disposal (TCLP, ignitability, corrosivity). The samples will be analyzed through EPA's DESA laboratory or a subcontracted laboratory. It is assumed that 5 drums of LNAPL will be generated and disposed of as hazardous waste.

Data from the LNAPL recovery tests will be analyzed using modified aquifer test procedures to account for LNAPL gradient and density factors. Several analytical methods are available and the appropriate method will be selected based on the characteristics of the data. The end product of the data evaluation will be an estimate of the range of LNAPL transmissivity and conductivity values. This data will be used in conjunction with the other lines of evidence gathered during this investigation to evaluate fluid recovery technologies that may be used to remove the free-phase LNAPL.

The water level and LNAPL thickness measurements, transducer data, and LNAPL characterization data (TCL organics, TAL metals, TCLP, ignitability, corrosivity, and reactivity) all generate definitive type data.

The following SOPs provided in Attachment B will be used to perform the test:

Standard Operating Procedures for LNAPL Recovery Pilot Test	
SOP Number	**SOP Topic**
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures
4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
9	Equipment Decontamination
14	Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers
24	LNAPL Recovery Testing and Sampling
31	LNAPL Sampling During LNAPL Recovery and LIF Characterization

4.2.7 AIR / BIO SPARGE PILOT TEST

Objectives

Air/bio sparging can be used to reduce the concentration of residual LNAPL contamination in the unsaturated or saturated zones in the subsurface. The process of sparging (i.e., injecting) air into the subsurface will both remove petroleum compounds through volatilization as well as promote the biodegradation of the petroleum compounds by increasing the concentration of oxygen in the soil and groundwater and stimulating the activity and growth of the natural bacterial populations. A pilot scale test of the air/bio sparge technology will be performed to develop information that can be used to evaluate the applicability of this technology to site conditions including the layout and estimated costs for the full-scale system.

Given the shallow depth to water and the depth to the semi-confining low permeability layer beneath the site (peat), the test will be conducted using a horizontal sparge well. Vertical sparge points in the geologic conditions at the site will likely have a low radius of influence, resulting in a very large number of sparge points for the needed areal coverage. Horizontal sparge wells are expected to be as effective and less costly.

Implementation

The air/bio sparge activity will begin with installation of a horizontal sparge well. A subcontractor will be procured to excavate a trench and construct the sparge well.

The trench will be approximately 30 feet long to a depth of about 10 feet below ground surface and will be extended to the depth that corresponds with the top of the silty clay unit. The bottom 6 inches of the trench will be filled with certified clean Global #5 sand (or equivalent), which will serve as the base over which a 2 inch-diameter SCH 80 PVC well screen with 0.020-inch slot size will be placed. The pipe will terminate at both ends with solid 90-degree PVC elbows and 2-inch SCH 80 PVC casing that is 12 feet long or extends at least 2 feet above the ground surface.

The subcontractor is responsible for any dewatering needed to construct the trench. Dewatering will be sufficient to provide clear and dry access to the trench for installation of sand, pipe, and bentonite materials.

Once the pipe and screen are installed, the trench will be backfilled in one of the two methods described below based on the need for dewatering of the trench during installation. The backfilling approach will be selected in the field based on encountered conditions.

1) If trench dewatering is NOT required: The perforated pipe will be covered with 12 inches of Global #5 sand (or equivalent). Next, the native materials excavated from the trench will be used to backfill to the elevation that groundwater is encountered (estimated to be approximately 3 feet below ground surface). The native materials will then be covered by at least 3-inches of 3/8-inch bentonite chips and the bentonite will be hydrated using clean potable water. The remainder of the trench will be backfilled to the surface with native material and compacted with the excavator bucket.

2) If the trench is dewatered: The perforated pipe will be covered with 12 inches of Global #5 sand (or equivalent). The sand will be covered by a minimum of 3-inches of 3/8-inch bentonite chips that will be hydrated using clean potable water. The native materials excavated from the trench will then be used to backfill the remainder of the trench to ground surface and will be compacted with the excavator bucket.

To monitor the system operation, five temporary, 1-inch diameter temporary piezometers will be installed using direct push technology. The piezometers will be installed in locations that are relatively close to the sparge trench in areas where there are not existing wells. The locations will be set to create a network of monitoring points that range in distance from the trench from 5 to 50 feet. Well points will be placed on both sides of the trench unless site conditions limit access.

The locations of both the trench and the piezometers will be selected in the field after the vegetation is cleared and site conditions are visible.

The temporary piezometers will be installed with direct placement (i.e., no sand pack) and constructed of Schedule 40 PVC with 0.010-inch (10-slot) slotted screen. A two-foot screen interval will be used that will be installed at the depth of the horizontal well and approximately screening the 8 to 10 foot interval below ground.

At the end of this task, CH2M HILL will survey (using GPS) the centerline of the trench and the locations of the riser pipes as well as the locations of the points installed to monitor the test. The vertical elevation of the temporary piezometer casing will be surveyed using transit level techniques.

Equipment for the sparge pilot test will be procured from a rental subcontractor. The equipment will be trailer-mounted for easy mobilization and demobilization and will consist of an air compressor or blower capable of producing 30 scfm at 20 psi. Process control will include valves to control flow to the subsurface or to bleed air. One component of the system will be a 50KW generator to supply power for the unit. A licensed electrician will be procured to connect the power at the beginning of the program and disconnect the power at the end of the pilot test.

The sparge test will be conducted by first starting at low injection rates, demonstrating that steady-state conditions are achieved, and then stepping up to a higher injection rate. This process will be continued until maximum injection rates, estimated to be less than 1 scfm per foot of well screen, are achieved. The Air/Bio sparge SOP provides details on the exact testing process including collection of baseline and monitoring data.

Field parameters in groundwater will be monitored during the test including dissolved oxygen, specific conductivity, pH, temperature, and oxidation-reduction potential. Field parameters in vapor will also be monitored to include volatile organic compounds (VOCs) using a photo-ionization detector (PID), oxygen, carbon dioxide, and methane.

Groundwater samples will be collected from the temporary piezometers before and at the end of the test using a peristaltic pump and the low flow sampling methodology. Due to the nature of the temporary well points and the inability to get a bailer into the temporary casing, the samples will be collected directly from the peristaltic pump discharge. The samples will be sent for analysis for TCL-VOCs through the CLP program. Because the data will be used for screening purposes, no quality control samples other than equipment blank and a trip blank will be collected and no data validation will be requested. In addition, samples from the temporary well points before and at the end of the test will be sent for heterotrophic plate counts through EPA's DESA laboratory or a subcontracted laboratory.

Laboratory and field parameter data will be compared to pre-test data, and the data will be interpreted to identify sparge criteria (radius of influence and well spacing, flow rates and pressures, etc) for use in evaluating this technology in the FFS.

The groundwater TCL VOCs, heterotrophic plate counts, and groundwater field parameter data will generate screening type data.

The following SOPs provided in Attachment B will be used to perform the test:

Standard Operating Procedures for Air/Bio Sparge Pilot Test	
SOP Number	**SOP Topic**
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures
4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements

Standard Operating Procedures for Air/Bio Sparge Pilot Test	
SOP Number	**SOP Topic**
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
8	Horiba Multi Parameter Water Quality Monitoring System
9	Equipment Decontamination
11	Borehole Abandonment
12	Monitoring Well and Piezometer Design and Construction
13	Monitoring Well and Piezometer Development
15	Low Stress (Low Flow) Groundwater Purging and Sampling
25	Air/bio Sparge Pilot Test Including Confirmatory Groundwater Sampling
28	Global Positioning System Survey Methods
29	Transit Level and Stadia Rod for Elevation Measurements

4.2.8 GEOPHYSICAL SUBSURFACE UTILITY CLEARANCE

The objective of this task is to use surface, non-invasive geophysical methods, to identify underground utilities or other obstructions to drilling at the selected boring areas.

Prior to initiating any of the Phase 2 on-site subsurface intrusive activities (e.g.; landfill trenching, air/bio sparge trenching, LIF drilling) the New Jersey One Call system will be utilized to identify and mark subsurface utilities at the site. During the Phase 1 investigation the NJ-1-Call system was used and a subcontracted utility delineation company performed on-site geophysical surveys to inspect for utilities at all Phase 1 drilling locations. No utilities were identified at the site; therefore onsite screening for utilities is not planned as part of the Phase 2 activities.

Prior to performing intrusive LIF investigation work in the cloverleaf area of I-280 which is known to have electrical and sewer utilities, a utility delineation markout will be performed by a subcontracted geophysics firm. The subcontracted firm will use surface geophysical instruments to detect and mark the location of buried utilities within the entire area of the cloverleaf that will be included in the LIF delineation work. These methods will be employed in addition to the utility mark-out which will be made by the New Jersey One Call System to indicate utility lines to the property boundary.

No analytical data will be collected during the geophysical survey task.

Utility clearance will be performed by a subcontractor in a single mobilization. The entire clover leaf area will be scanned for underground utilities. To ensure the detection of the widest possible range of subsurface utilities and structures, one or more of the geophysical methods and instruments listed below will be used. The actual instruments or methods used will depend on the encountered field conditions and results. All instruments will be used in accordance with the manufacturer's instructions.

<u>Ground penetrating radar (GPR)</u> – A GPR will be used to scan sampling locations or the areas around and leading to these locations for subsurface nonmetallic or metallic utilities/structures. GPR systems produce cross sectional images of subsurface features and layers by continuously emitting pulses of radar frequency energy from a scanning antenna as it is towed along a survey profile. The radar pulses are reflected by interfaces between materials with differing dielectric

properties. The reflections return to the antenna and are printed on a strip chart recorder or displayed on a video monitor as a continuous cross section in real time. Since the electrical properties of metal are distinctly different from soil and backfill materials, metallic pipes and other structures produce dramatic and characteristic reflections. Fiberglass, plastic, concrete, and terra cotta pipes and structures also produce recognizable, but less dramatic reflections. Additional geophysical methods may also be required in areas with saturated soil as moisture content may provide signal interference for the GPR.

<u>Electromagnetic (EM)</u> – The survey areas will also be scanned with an EM instrument such as the Fisher TW -6 pipe and cable locator and tracer. In pipe and cable search mode, the TW-6 is essentially a deep-sensing metal detector which detects any electrically conductive material. As the instrument is swept along the ground surface, subsurface metallic bodies distort the electromagnetic field created by the transmitting coil. The change in field strength is sensed by the receiver, setting off an audible alarm and/or causing deflection of an analog meter. The TW-6 can nominally detect a 2-inch metal pipe to a depth of 8 feet and a 10-inch metal pipe to a depth of 14 feet. In pipe and cable tracing mode, the TW-6 transmitter can be coupled directly (conductively) to exposed portions of a metallic pipe, cable, or wire or inductively to a subsurface metallic utility with known location and orientation. The transmitter remains stationary and energizes the utility, which can then be traced at the ground surface using the mobile TW-6 receiver. Depths to metallic structures or utilities can be determined (to within approximately 0.5 feet) using inductive or conductive mode triangulation.

Another instrument that may be used is the Radio detection CAT& Genny system operating in a fashion similar to the TW -6 in pipe tracing mode but with a different signal frequency. The CAT & Genny also has the capability of tracing an active sonde or mole inserted into an accessible pipe (1.5 inch diameter or greater) on flexible push rods. The sonde is nominally detectable to a depth of 16 feet, and is therefore particularly useful for tracing deep and/or non-metallic sewer lines.

In areas that may have limited GPR depth penetration (e.g. due to site-specific soil conditions or the presence of metallic reinforcing), a Geonics EM-61 instrument may be employed to locate metallic structures. The EM-61 uses a one meter square coil to transmit 150 electromagnetic pulses per second into the ground at closely spaced (e.g. 3 inches) measurement stations. A second transmitter coil is used to narrowly focus the pulses, making the instrument insensitive to overhead and/or nearby sources of electromagnetic interference such as buildings, fences, power lines, surficial debris, and atmospheric electromagnetic activity. During the off-time between transmitted pulses, a receiver coil measures the decay of transient electrical currents induced by the transmit pulses. Electrical currents in moderately conductive earth materials (e.g. damp clays, mineralized or oxidized soils, etc.) dissipate rapidly, leaving the more prolonged currents resulting from buried metallic objects to be detected. The EM-61 detects and measures the prolonged transient currents, providing a digital read-out of the metallic content of the subsurface at depths up to approximately 12 feet. Note that the EM-61 focusing coil can be used to minimize the response from surficial metallic debris, which would mask the presence of deeper metal from standard EM, metal detector, or GPR instruments. For structures or utilities detected with the EM-61, the target depth can be estimated using the standard signal-width-at -half -amplitude relationship.

<u>Magnetic methods (magnetometer/gradiometer)</u> - Sampling locations may also be screened with a Fisher FX-3 MAG instrument. The FX3 contains two elements that measure the difference in total strength of the earth's magnetic field between two fixed heights above the ground surface (i.e. the magnetic gradient). In the absence of artificial magnetic fields or buried ferromagnetic objects, the

natural gradient of the earth's field is relatively constant. Where buried magnetic or ferromagnetic objects (e.g. magnetite or iron/steel respectively) are present, the gradient varies rapidly as the instrument is swept along the ground surface, triggering an audible alarm. The MAG instrument that may be employed for this survey would nominally detect a 2-inch steel pipe to a depth of 4 feet.

4.2.10 SURVEYING

Surveying of sampling locations and investigation features will be performed by CH2M HILL staff throughout the field implementation process. A Trimble Pathfinder™ Pro XRS global positioning system (GPS) or equivalent unit will be procured to determine horizontal positions (latitude and longitude) to 1 meter accuracy. A field survey will be performed for investigation features including the temporary roadways, landfill excavation trenches, LIF boring locations, pilot test trench, and temporary peizometers.

CH2M HILL will also utilize transit level and stadia rod techniques to measure elevations for the temporary piezometers. The existing monitor wells at the site have previously been surveyed and their elevations are known. These monitor wells will therefore serve as the benchmark for elevations using the transit level and stadia rod.

The coordinate system and elevation datums will be the same as used in preparation of the Phase 1 site plan. The vertical elevations will be surveyed to an accuracy of 0.01 foot referenced to the National Geodetic Vertical Datum 1929.

The following three elevation points will be established for each temporary piezometer:

- The top of the piezometer casing (PVC well riser)
- The ground surface on the north side of each piezometer

The survey work will be performed during the implementation of each stage of the investigation.

No analytical data will be collected during the surveying task.

The following SOPs provided in Attachment B will be used to perform the surveying:

Standard Operating Procedures for Surveying	
SOP Number	**SOP Topic**
3	Field Logbook Procedures
28	Global Positioning System Survey Methods
29	Transit Level and Stadia Rod for Elevation Measurements

4.2.11 WATER LEVEL MEASUREMENTS AND LNAPL THICKNESS MEASUREMENTS

Water level measurements (for groundwater potentiometric maps), and LNAPL thickness measurements will be collected as part of the hydrogeologic investigation and baseline information for the LNAPL Recovery Pilot Test.

Two rounds of synoptic water level elevation and LNAPL thickness measurements will be collected from the 15 shallow monitoring wells above the peat layer, 5 shallow monitoring wells below the peat layer, and 17 piezometers existing at the site from the Phase I Investigation (36 measuring points within the 15 acre site per event). The first measurement round will be performed at the beginning of the investigation during the mobilization phase. This data set will serve as the baseline for current site conditions prior to commencing the LIF investigation and will be compared to the data collected during Phase I. The second measurement round will be performed at the beginning of the LNAPL Recovery Test and will be the baseline for this phase of the investigation.

The water level elevations and product thickness measurements will be collected manually by two CH2M HILL staff to obtain a synoptic data set in the shortest amount of time practicable. Measurements will be collected using oil/water interface probes.

The water level data will be used to generate groundwater piezometric maps for the determination of hydraulic gradients and groundwater flow directions at the site, and the product thickness measurements will be utilized to evaluate the extent and thickness of the LNAPL plume and its effects on groundwater quality at the site.

No samples will be collected for laboratory analysis during these investigation activities. All of the data collected during the water level measurements and LNAPL thickness measurements will be screening type data.

The following SOPs provided in Attachment B will be used to collect the measurements:

Standard Operating Procedures for Water Level and LNAPL Thickness Measurements	
SOP Number	**SOP Topic**
3	Field Logbook Procedures
4	Field Parameter Forms
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
9	Equipment Decontamination
14	Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers

4.2.12 IDW MANAGEMENT AND DISPOSAL

Investigation derived waste will be containerized and managed onsite for ultimate manifesting and disposal at EPA approved off-site disposal facilities. Waste streams will include PPE, decontamination water, soil from soil coring and sampling, waste LNAPL from product recoverability testing, and potentially groundwater from dewatering during construction of the air/bio sparge trench.

Based on historic TCLP data from the Phase I Investigation, it is assumed that PPE, decontamination water, and soil will be disposed of as non-hazardous waste and that the LNAPL will be classified as hazardous waste. This is believed to be a reasonable assumption as the wastes generated during this phase of investigation will be derived from the same areas as the wastes generated during the Phase 1 activities. In addition, activities are not expected to have taken place at the site between the Phase 1 and this investigation that could have affected the nature and extent of the contamination and therefore the waste classification.

Estimates of the quantities of each waste stream expected to be generated (not including any drums discovered during the landfill investigation) are provided below:

Table 4 Summary of IDW Waste Streams

Waste	Disposal Classification	Container Type	Estimated Quantity
PPE	Non-Hazardous	55-Gallon Drum	5 drums
Decontamination Water	Non-Hazardous	55-Gallon Drum	10 drums
Soil	Non-Hazardous	55-Gallon Drum	2 drums
LNAPL	Hazardous	55-Gallon Drum	5 drums

All waste streams will be staged in a designated area of the site. Each drum will be labeled and waste streams segregated in accordance with the procedures outlined in Attachment A – Site Management Plan.

A subcontractor will be procured for transportation and disposal of the IDW wastes. Prior to disposal, all transportation companies and disposal facilities will be reviewed and pre-approved by USEPA. Appropriate manifests or bills of laiding will accompany the wastes and will be maintained as project tracking documents.

The following SOPs provided in Attachment B will be used to sample IDW:

Table 6 List of Standard Operating Procedures for IDW Sampling

SOP Number	SOP Topic
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures
4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
9	Equipment Decontamination
32	Sampling of Liquid IDW and Fire Hydrant

4.2.13 DECONTAMINATION PROCEDURES

The purpose of decontamination is to remove all foreign chemical compounds from non-disposable field sampling equipment in order to prevent the equipment from artificially introducing chemical constituents into samples during collection or other sampling activities (e.g., drilling, etc.). If any chemical compounds or inorganic constituents are introduced into a sample as a result of contact with contaminated field sampling equipment, the validity and resulting data quality is compromised. Decontamination assists in ensuring that the field samples collected and the resulting analytical data are representative of actual site conditions, and that the established DQOs are not impacted. The effectiveness of field decontamination procedures will be assessed through the collection and analysis of blanks (a.k.a. equipment rinsate blanks).

Depending on the type of equipment to be decontaminated, the decontamination procedures utilize multiple stages of rinsing/washing fluids and/or pressurized steam that are known to be free of the analytes of interest. The fluids/steam will be passed through and/or over non-disposable equipment according to established procedures to remove potential contaminants and prevent cross-contamination between sampling locations. All non-disposable equipment involved in field sampling activities will be decontaminated prior to sampling. Equipment leaving the site will also be decontaminated. Attachment B contains a detailed SOP that will be used by field personnel in decontaminating equipment. This procedure is also summarized below.

All direct push technology drilling equipment will be hand washed prior to use with the option for steam cleaning if after hand washing the equipment remains soiled. Well screens and riser pipe, if not cleaned and fully encased in plastic by the manufacturer, will also be steam-cleaned to remove any cutting oils or soil from shipping. The equipment will be stored on clean polyethylene sheeting. Pressurized steam will be used to remove all visible excess material from drill steel, drill bits, the back of the drill rig, and any other parts of the rig which may contact the media under investigation. If visible contamination still exists on the equipment after the rinse, a non-phosphate detergent scrub will be added, and the equipment thoroughly rinsed again with pressurized steam. Steam cleaning will be conducted on the decontamination pad, which will be constructed on-site for the field investigation. All decontamination water will be collected and containerized in drums.

Field instrumentation (such as interface probes, pressure transducers, pH meters, etc.) and equipment used for hydrogeologic testing, downhole geophysical logging, and other non sampling uses will be decontaminated between sample locations by rinsing and wiping with DI water and paper towel. If visible contamination still exists on the equipment after the rinse, a non-phosphate detergent scrub and rinse will be added, and the probe thoroughly rinsed again with DI water.

Decontamination of all non-disposable, non-electrical sampling equipment (including sampling bowls, trowels, shovels, etc.) will be conducted as described below:

1. Non-phosphate soap (e.g., Liquinox) and potable water scrub.
2. Potable water rinse.
3. A 10% by volume nitric acid rinse (ultra pure grade) when sampling for inorganics, unless using carbon steel sampling equipment when a 1% by volume nitric acid solution should be used to avoid stripping of metals.
4. DI water rinse.
5. 10 % by volume Methanol rinse
6. Air dry.
7. DI water rinse.
8. Air dry.
9. Wrap or cover exposed portions of equipment with aluminum foil (shiny surface out) for transport and handling

For low flow purge and sampling of any non-disposable pump systems, the decontamination procedures will be as specified by the current version of the Region II Low Flow Standard Operating Procedures, as follows:

Non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, must be decontaminated thoroughly each day before use (daily decon) and after each well is sampled (between-well decon). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using daily decon procedures (see i. below) prior to their initial use and/or installation. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled (between-well decon).

i. Daily Decon

A. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for five minutes and flush other equipment with potable water for five minutes.

B. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox, for five minutes and flush other equipment with fresh detergent solution for five minutes. Use the detergent sparingly.

C. Rinse: Operate pump in a deep basin of potable water for five minutes and flush other equipment with potable water for five minutes.

D. Disassemble pump.

E. Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a stiff brush.

F. Rinse pump parts with potable water.

G. Rinse the following pump parts with distilled/deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing

H. Place impeller assembly in a large glass beaker and rinse with a 1% by volume nitric acid (HNO_3) solution.

I. Rinse impeller assembly with potable water.

J. Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K. Rinse impeller assembly with distilled/deionized water.

ii. Between-Well Decon

A. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for five minutes and flush other equipment with potable water for five minutes.

B. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox, for five minutes and flush other equipment with fresh detergent solution for five minutes. Use the detergent sparingly.

C. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for five minutes.

D. Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

The need to decontaminate sampling equipment during the Diamond Head RI will be kept to a minimum in the field by, wherever possible, utilizing disposable sampling equipment. Decontamination fluids will be stored in 55-gallon drums for proper disposal. Personnel involved in equipment decontamination will wear protective clothing, as stated in the Health and Safety Plan in Attachment C.

The guidance documents reviewed during the preparation of this section are listed in Section 16.0.

4.2.14 AIR MONITORING

The air quality investigation conducted during the field investigation will consist of real-time monitoring of the ambient air during intrusive activities (e.g., landfill excavation, Air/Bio Sparge trench construction, LIF probe drilling). The monitoring program is described in detail within the Health and Safety Plan (HASP) in Attachment C and is summarized below.

Air quality monitoring will be conducted for worker safety purposes. Real-time air quality data will be compared to exposure action levels, which if exceeded, will trigger the need for corrective action. The exposure action levels will be used to ensure that potential community exposures (at the site perimeter) to airborne contaminants are maintained at levels no greater than one order-of-magnitude less than occupational exposure limits. Because the developed action levels are based on existing site-specific contaminant data (types of contaminants, concentrations, media, exposure limits) and instrument responsiveness, these action levels are considered to be conservative. The air monitoring and associated action levels will be as follows:

Table 5 Air Monitoring Requirements

Instrument	Tasks	Action Levels[a]		Frequency[b]	Calibration
PID: MultiiRae PID with 11.7eV lamp or equivalent	All intrusive tasks	Background→ B.G. – 5ppm→ 5-500 ppm → 0-10% :→ 10-25% LEL:→ >25% LEL:→ B.G.–5ppm (H_2S)→ 5 – 50ppm(H_2S)→ >50ppm (H_2S)→	Level D Level C Level B- Not Authorized No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent Level D Level C (PAPR) Level B-Not Authorized	Initially and periodically during task	Daily
CGI: Gem 2000 Plus or equivalent	Landfill trenching	0-10% :→ 10-25% LEL:→ >25% LEL:→ B.G.–5ppm (H_2S)→ 5 – 50ppm(H_2S)→ >50ppm (H_2S)→	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent Level D Level C (PAPR) Level B-Not Authorized	Continuous during advancement of trench	Daily
CGI: MultiRae or equivalent	Drilling	0-10% :→ 10-25% LEL:→ >25% LEL:→ B.G.–5ppm (H_2S)→ 5 – 50ppm(H_2S)→ >50ppm (H_2S)→	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent Level D Level C (PAPR) Level B-Not Authorized	Continuous during advancement of boring	Daily
Dust Monitor: Visual	Drilling Excavating	Visual Dust→	Utilize Engineering controls (e.g. water or /fans)	Initially and periodically during tasks	Not Applicable
Nose-Level Monitor[e]: Voice	Drilling Excavating Heavy Equipment Use	Must raise voice and shout to communicate at 3 feet→	Hearing protection required Stop; re-evaluate	Initially and periodically during task	Not Applicable

[a] Action levels apply to sustained breathing-zone measurements above background.

[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).

[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry (refer to Section 2).

[d] Refer to SOP HS-10 for instructions and documentation on radiation monitoring and screening.

[e] Noise monitoring and audiometric testing also required.

The following SOPs provided in Attachment B will be used to monitor ambient air during the RI activities:

Standard Operating Procedures for Ambient Air Monitoring	
SOP Number	**SOP Topic**
3	Field Logbook Procedures
4	Field Parameter Forms
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)

4.2.15 FIELD TECHNICAL GUIDELINES

Standard Operating Procedures will be used to implement all field activities. Their purpose is to provide field personnel with concise and clear procedures to follow in performing the remedial investigation activities. This will ensure consistent and quality performance by the field personnel.

The SOPs to be used during the Phase 2 RI are provided in Attachment B. The list is provided below. SOPs in italics were developed specifically for the Phase 2 activities.

Table 6 List of Standard Operating Procedures	
SOP Number	**SOP Topic**
1*	Sample Nomenclature
2*	CLP and DESA Laboratory Chain-of-Custody Procedures
2a**	NON CLP Laboratory Chain-of-0Custody Procedures
3	Field Logbook Procedures
4*	Field Parameter Forms
5*	Sample Collection, Bottle, Preservation and Filtration Requirements
6*	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
8	Horiba U-10/U-22 Multi-Parameter Water Quality Monitoring System
9	Equipment Decontamination
10	Boring Installation Methods and Soil Sampling: RotaSonic Drilling
11	Borehole Abandonment
12	Monitoring Well and Piezometer Design and Construction
13	Monitoring Well and Piezometer Development
14	Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers
15	Low Stress (Low Flow) Groundwater Purging and Sampling
16	Subsurface Soil Sampling
17	Collection and Preservation of Soil Samples for VOC
18	LNAPL Shake Test
19	Monitoring for Tidal Influences
20	Surface Water Sampling
21	Sediment Sampling
22	Natural Gamma Borehole Logging
23**	LIF and Confirmatory Soil Sampling
24**	LNAPL Recovery Testing and Sampling

Table 6 List of Standard Operating Procedures	
25**	Air/bio Sparge Pilot Testing
26**	Vegetation Clearance and Road Construction Documentation
27**	Landfill Trenching and Documentation of Landfill Materials
28**	Global Positioning System Survey Methods
29**	Transit Level Rod for Elevation Measurements
30**	Sampling of Soil During Landfill Trenching
31**	LNAPL Sampling During LNAPL Recovery and LIF Investigation
32**	Sampling of Liquid IDW and Fire Hydrant
33*	Data Management

*Indicates SOP revised from Phase 1

** Indicated new SOP developed for Phase 2

17.0 REFERENCES

References below are additional to references in Phase 1 SAP.

"A Methodology for Estimating LNAPL Conductivity and Transmissivity from LNAPL Bail down Tests: The Lundy and Zimmerman Approach" by Don Lundy (Environmental Systems and Technologies, a Division of Groundwater and Environmental Services, Inc.)

"A Protocol for Performing Field Tasks and Follow-up Analytical Evaluation for LNAPL Transmissivity Using Well Bail down Procedures" by G. D. Beckett (Aqui-Ver, Inc.) and M.A. Lyverse (ChevronTexaco Energy Research and Technology Company), August 2002.

Figures

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Figure1
Proposed Temporary Gravel Road, Landfill Excavations, and Delineated Wetland Location Map
Diamond Head Phase 2 RI/FS
Kearny, New Jersey 07032

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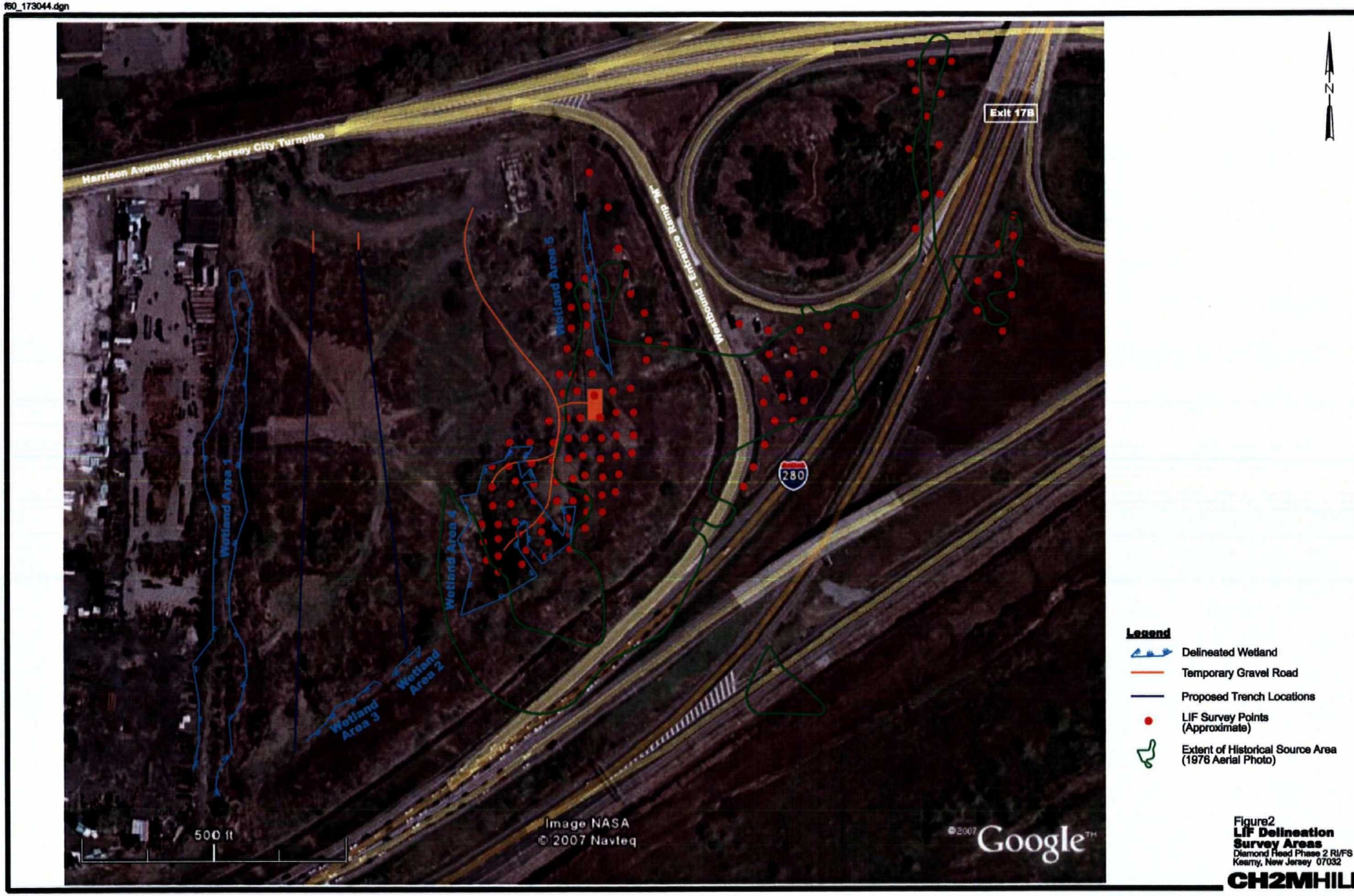


Figure2
LIF Delineation Survey Areas
Diamond Head Phase 2 RI/FS
Kearny, New Jersey 07032

CH2MHILL

ATTACHMENT A

Updated
Site Management Plan
(SMP)
(submitted under separate cover)

ATTACHMENT B

Updated Standard Operating Procedures (SOPs)

STANDARD OPERATING PROCEDURE
SAMPLE NOMENCLATURE

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for designating sample numbers during the Diamond Head Oil – Superfund Site Phase 2 Focused RI/FS. Every sample will have a sample number uniquely identifying the sampling point and phase of sampling.

2.0 Materials

None required.

3.0 Procedure

3.1 Each sample collected during the field investigation will be assigned a unique identification number and alpha-numeric code. The code will provide information on the following:

- The sample location which will describe the distinguishing media:

  LIF – soil boring installed for the LIF investigation (including the locations where soil cores will be collected for visual observations and laboratory testing)
  SB – soil boring installed to collect soil samples (these are the locations where the samples for SPLP testing will be collected)
  TPZ – temporary piezometers where groundwater samples will be collected in support of the air / bio sparge
  FP – Free product sample
  LTR – Landfill trench, LTR-E for the east trench and LTR-W for the west trench
  WW – IDW water from decontamination activities
  WFP – IDW free product from the LNAPL recovery test
  FH – Fire hydrant water used during decontamination activities

<u>FOLLOWED BY</u>

- For LIF - the number of the LIF location in three digits (example, LIF-001)
- For SB – number of the boring, staring at 39 which is the next number after the Phase 1 SB numbers (example, SB-39)
- For TPZ - the number of the TPZ location in two digits (example, 01); ten locations are planned (example, TPZ-01)
- For FP – the location of the well where the sample was collected (FP-MW-03S)

- For LTR-E and LTR-W – the number of the sample within the trench in two digits (example, LTR-E-01)
- WW – A sequential number for this phase
- WFP – A sequential number for this phase
- FH – A sequential number for this phase

FOLLOWED BY

- For LIF – the range in depth at which the sample was collected below ground surface. Each depth will be recorded as "feet" in two digit numbers (i.e., 02-07) (example, LIF-001-02-07)
- For SB – the range in depth at which the sample was collected below ground surface. Each depth will be recorded as "feet" in two digit numbers (i.e., 02-07) (example, SB-39-02-07)
- For TPZ - 01 for samples collected before the air / bio sparge test and 02 for samples collected after the air / bio sparge test (example, TPZ-01-01)

FOLLOWED BY

- For all samples – the number of this phase of RI sampling - 2.

A summary of all the samples planned to be collected is provided in the table at the end of this SOP.

3.2 The QA/QC samples that will be collected and the procedures to follow in assigning sample numbers will be as follows:

D – Duplicate This sample consists of one additional sample volume for each type of analysis collected in separate bottle(s) from the native sample. **Duplicate samples will be submitted to the laboratory as blind samples, and will therefore not include any nomenclature or time designation that could correlate the duplicate sample to the native sample.** The media from which the sample is collected is not included in the nomenclature, and the time of the sample is not included on the traffic report. Duplicate samples will be analyzed for the same parameters as the native sample. The duplicate nomenclature will be indicated by a D followed by:

The sampling round (2) of the RI
the month
the day
the year
a number indicating the sequence of duplicates collected that day in two digits

For example, the first duplicate sample collected on January 15, 2008 would be designated: D-2-01-15-08-01. The second duplicate collected on the same day would be D-2-01-15-08-02.

E – Equipment Rinsate Blank This sample is collected by pouring Type II DI water over a decontaminated piece of equipment. A sample volume is collected for each type of analysis. Equipment rinsate blanks receive a unique sample number and are analyzed for all parameters being sampled for using the particular piece of equipment being decontaminated. Equipment rinsate blank sample numbers will be indicated by an E followed by:

The sampling round (2) of the RI
the month
the day
the year
a number indicating the sequence of blanks collected on that day

For example, E-2-01-15-08-02 is the second Equipment rinsate blank collected on January 15th, 2008.

T – Trip blank This sample is collected only when aqueous samples for VOC analyses are collected. The trip blank is comprised of two 40 ml vials of Type II DI water for VOC analysis, which are included in every sample cooler containing samples for aqueous VOCs analysis. Trip blanks receive a unique sample number and are analyzed for VOCs. Trip blanks sample numbers will be indicated by a T followed by:

The sampling round (2) of the RI
the month
the day
the year
a number indicating the sequence of blanks collected on that day

For example, T-2-01-15-08-02 is the second trip blank collected on January 15th, 2008.

MS/MSD – Matrix Spike/Matrix Spike Duplicate This sample consists of additional sample volumes for each type of analysis collected in separate bottle(s) from the actual sample. The amount of additional volume needed depends on the media being sampled. For soil samples, one additional volume is required; for aqueous samples, two additional volumes are required. MS/MSDs require unique sample designation. MS/MSDs will be indicated by attaching "**– MSD**" at the end of the sample number.

Temperature blanks These samples consist of potable water collected in an unpreserved 40 ml vial and labeled "Temperature Blank" with the date the blank was generated. Temperature blanks will be included with all samples requiring a preservative of 4° Celsius. No sample nomenclature needed.

3.3 An Excel spreadsheet will be developed, which will be used to record laboratory sample numbers assigned to each sample and track the shipment of samples, COC information, and receipt of the results from the laboratories.

3.4 All sample location and identification information will be recorded in the field logbook and other applicable field forms.

3.5 Using the established nomenclature, record the following information on each label in indelible ink:

- Project name
- Sample location/site ID
- Sampling date and time
- Analyses to be performed
- Preservative and
- Sampler's name.

Field staff personnel will be required to write the sample ID on the samples label.

3.6 Double-check the label information to make sure it is correct. Detach the label, remove the backing and apply the label to the sample container. Cover label with clear tape.

3.7 Record the Sample Number, the CLP sample number (when applicable), and designated sampling point in the field logbook, along with the following sample information:

- Time of sample collection (each logbook page should be dated).
- The location of the sample.
- Field screening measurements (e.g., PID readings), when appropriate.
- Any unusual or pertinent observations.
- Whether the sample is a QC sample (e.g., field duplicate, blank).

3.8 Place the sample in the designated sample cooler. For intact core samples, make sure there is a sufficient amount of dry ice in each cooler to ensure each sample remains flash frozen. Coolers containing samples which require a preservative of 4° Celsius (39.2°F) must have enough ice in the cooler at all times in order to maintain the samples at 4°± 2°C from the time of sample collection until delivery to the laboratory.

3.9 Provide the copies of the COCs weekly to the Project Manager.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Accurate sample nomenclature is critical to successful completion of the project.

6.0 References

None.

7.0 Attachments

Table 1 – Sampling Rationale and Nomenclature

STANDARD OPERATING PROCEDURE
CLP AND DESA LABORATORY
CHAIN-OF-CUSTODY PROCEDURES

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the use of the EPA CLP Chain-of-Custody (COC) forms for documenting and tracking organic and inorganic samples. These forms will be completed through the EPA FORMS II Lite Software. Refer to the software documentation for specific details on its application and for examples of the COC forms. The forms are used to ship samples to CLP laboratories and the EPA Region 2 DESA laboratory.

2.0 Materials

1. EPA FORMS II Lite Software, Version 5.1 (or latest available version)
2. Laptop computer and laser printer (with printer labels)
3. Indelible black ink pen

3.0 Procedure

3.1 Enter the 5-digit case number provided by EPA's RSCC.

3.2 Give the project name, project code

3.3 Enter CH2M HILL Point of Contact (name and phone number).

3.4 Enter the names of the samplers.

3.5 List the sample number assigned by EPA (the CLP number), the sample number (see the sample nomenclature SOP), and any appropriate QC sample qualifier. Both the CLP sample number and the project-assigned sample number will be entered into the project database. The database can then be queried for strings of characters in the project-specific identifier (e.g., all soil samples from a particular interval in all soil borings, all field rinse blanks, or other). **Note that EPA CLP numbers never utilize the letters "O, U, V, or I", but do utilize the numerals "1, and 0".**

3.6 Indicate the date of sample collection.

3.7 List the sampling times (24-hour format) for all samples.

3.8 Indicate "grab" or "composite" sample

3.9 Indicate the matrix sampled (e.g., soil, water)

3.10 Identify level of concentration (e.g., low, medium, or high)

3.11 Indicate the analyses per sample location.

3.12 Indicate whether the shipment for the sampling analysis is complete. Complete indicates that all shipments of samples to this laboratory under this CLP Case number are completed. No more samples will be shipped to the lab using this CLP Case number (e.g., if you are collecting samples tomorrow using this CLP Case number, the sampling is NOT complete).

3.13 List the preservation requirements for each analysis.

3.14 State the carrier service and air bill number, and analytical laboratory.

3.16 Upon completion of the form print one "Laboratory Copy" and place inside of the sample cooler to be sent to the designated CLP laboratory. Make a photo copy for project records.

3.17 Print one copy of the "Region Copy" to be faxed nightly to the EPA Sample Manager or RSCC and then sent as a hard copy with the end of sampling case CLP Case Report Summary. Make a photocopy for project records.

Note that the "Laboratory Copy" and "Region Copy" of the COC forms are formatted slightly differently and contain different information.

3.15 Sign, date, and time the "relinquished by" section on ALL copies of the COC's.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Sample personnel should be aware that a sample is considered to be in a person's custody if the sample is: (a) in a person's actual possession; (b) in view after being in a person's possession; (c) secured for storage such that no one can tamper with it after having been in their physical custody.

6.0 References

USEPA. Introduction to the CLP, EPA540-R-07-02, OSWER 9240.0-42, January 2007.

USEPA. CLP Guidance for Field Samplers, EPA 540-R-07-06, OSWER 540-R-07-06, Final, July 2007.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE
NON CLP LABORATORY
CHAIN-OF-CUSTODY PROCEDURES

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the use of the Chain-of-Custody (COC) forms for documenting and tracking organic and inorganic samples as well as samples sent for specialty analysis to subcontracted laboratories. The COC record will be completed by the Sample Management Coordinator. Field team staff may be requested to assist the Sample Management Coordinator.

2.0 Materials

1. Laboratory provided COC forms
2. Indelible black ink pen

Procedure

1. Enter Laboratory Quote Number (if applicable).
2. Enter the appropriate Project Number (359471.03.02.01).
3. Enter CH2M Hill's Purchase Order Number.
4. Enter Project Name (Diamond Head Oil Superfund Site – Phase 2).
5. Enter Company Name/CH2M HILL office.
6. Enter date samples are shipped / picked up by the laboratory.
7. Enter the name of actual person (Juliana Hess) receiving data.
8. Enter CH2M Hills Project Manager's name (Juliana Hess).
9. Indicate the name of the person who should also receive a copy of the analytical data (Andrew Judd).
10. Indicate to the laboratory the requested date when data package should be completed (turn around time)
11. Indicate the name of person or persons who collected the samples.
12. Indicate level of validation (i.e. NJ Reduced).
13. Indicate EDD is requested, Excel format.
14. Enter the sample identification number.
15. Enter sample matrix description (i.e., soil or water).

16. Enter sample type (i.e., grab or composite).
17. Indicate preservative added to sample.
18. Put an "X" in the box or boxes indicating the analysis requested.
19. Enter the date samples were collected.
20. Enter the time (in military time) samples were collected.
21. Enter any important information the laboratory should know about the sample / shipment (i.e., MS/MSD samples, trip blanks). The sample for MS/MSD should be indicated in the comments section of COC.
22. Do not indicate duplicate samples on Chain-of-Custody form or labels sent to the laboratory. Submit duplicate samples as "Blind" in accordance with the Sample Nomenclature SOP.
23. Sign, date, and time the "relinquished by" section.
24. If samples are shipped by carrier, indicate carrier name. A signature is not necessary, provided this COC is sealed inside cooler at the time it is relinquished to the carrier.
25. Obtain "Client" copy of COC prior to shipment of cooler.
26. All "Client" copies of COC's will be filed in a project notebook kept on site for future reference.

4.0 Maintenance

Not Applicable.

5.0 Precautions

1. Sample personnel should be aware that a sample is considered to be in a person's custody if the sample is: (a) in a person's actual possession; (b) in view after being in a person's possession; (c) secured for storage such that no one can tamper with it after having been in their physical custody.

References

None.

Attachments

None

STANDARD OPERATING PROCEDURE
FIELD PARAMETER FORMS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to provide the field team with a complete set of field parameter forms.

2.0 Materials

a. Field logbook
b. Indelible ink pen
c. Blank forms (printed on all-weather paper)

3.0 Procedure

3.1 Field parameter forms (FPFs) will be used to record various types of field information. Once completed, the original FPF will be filed as part of the project documentation. Each FPF will be filed in a field parameter three-ring binder. All entries on FPFs will be made with an indelible ink pen. All corrections will consist of line-out deletions that are initialed and dated.

3.2 Below is a list of the FPFs; which will be used during the investigation:

3.2.1 **Sample Tracking Log**

1. Log will be used to track samples sent for analyses and receipt of validated results for samples sent for CLP analyses and unvalidated results for samples sent for analyses by subcontracted laboratories outside of the CLP.

2. Complete the log at the end of each day by filling-in the cumulative information for the samples collected during the day.

3. Maintain the log in a 3-ring binder Sample Tracking Logbook.

4. At the end of each week of field activities, provide a copy of the cumulative log to the Project Manager.

3.2.2 Soil Boring Logs; Test Pit Log; Well Completion Diagram; Low-Flow Groundwater Sampling: Field Data Sheet; Water level and LNAPL Thickness Measurements; Daily LNAPL Recovery Test Log; Air/Bio Data Sheet; Road Construction Record; Landfill Trenching Record

1. The appropriate forms will be used to record information during each Phase 2 activity.

2. Complete form at each location.

3. File in a designated 3-ring binder at the end of the day.

3.2.4 LIF Daily Summary, Daily Activity Summary, and Daily Construction Report

1. Reports will be used to document daily drilling and construction activities/progress and other significant activities.

2. Complete appropriate log(s) log each day.

3. File in a designated 3-ring binder at the end of the day.

3.2.5 Daily Equipment Record Sheet

1. Form will be used to document required calibration of each field instrument.

2. Complete log each day.

3. File in a designated 3-ring binder at the end of the day.

3.2.6 Field Change Request Form

1. Form will be used to request a change in approved field procedures.

2. Complete form and send to Project Manager prior to implementing change.

3.2.7 Sign-in Forms, Equipment Rental Tracking Log, and Investigation Derived Waste Drum Forms

1. Binders will be established and maintained in the trailer containing these forms.

4.0 Maintenance

Not Applicable.

5.0 Precautions

None.

6.0 References

None.

7.0 Attachments

Sample Tracking Log
Soil Boring Log
Test Pit Log
Well Completion Diagram
Water Level and LNAPL Thickness Measurements
LNAPL Recovery Pilot Test Log
Air/Bio Data Sheet
Low-Flow Groundwater Sampling: Field Data Sheet
Daily Equipment Calibration Record Sheet
Road Construction Record
Landfill Trenching Record
LIF Daily Summary
Daily Activity Summary
Daily Construction Report
Field Change Request Form
Staff Sign-In Log
Visitor Sign-In Log
Rental Equipment Tracking Log
Investigation Derived Waste Drum Log

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sample Type	Composite Yes or No	Sampling Method	Depth of Sample Top	Depth of Sample Bottom	Units	Sample Date	Sample Time	COC Date	Analysis	[illegible]	[illegible]	[illegible]
LIF - Soil Intact Core Sample																	
Example																	
LIF-87	LIF-87-10-13-2			SO	N	Y	Intact Core - Geoprobe	10	13	ft	1/27/2008	16:00	1/27/2008	Pore Fluid Saturation/ Core photography			
LIF - Soil SPLP Leachability																	
Example																	
SB-39	SB-39-07-09			SO	N	N	D.P.T	7	9	ft	2/28/2008	07:47	2/29/2007	SPLP for VOCs and SVOCs			
Soil (Landfill Investigation)																	
Example																	
LTR-E-01	LTR-E-01-2	BOFA7/MBODZ2	BOFA7	SO	N	N	Hand	9	10	ft	12/26/2007	13:29	12/26/2007	TCL-full, TAL-Metals	30706		
Groundwater (Air/Bio Sparge Evaluation) Sample																	
Example																	
TPZ-07	TPZ-07-1-2	BOFA8		GW	N	N	Low Flow				12/16/2007	10:07	12/16/2007	TCL-VOCs	30942		
TPZ-10	TPZ-10-2-2			GW	N	N	Low Flow				12/16/2007	10:07	12/16/2007	Bacteria Count			
LNAPL (Fluid Properties) Pair Sample																	
Example																	
MW-03	FP-MW-03-2			FP	N	N	Bailer				1/2/2007	14:07	1/2/2007	LNAPL Fluid Properties			
MW-03	GW-MW-03-2			GW	N	N	Bailer				1/2/2007	14:17	1/2/2007	LNAPL Fluid Properties			
IDW (Decontamination Water)																	
Example																	
WW	WW-01-02	BOEB9/MFOOV3		WW	N	N	Bailer				3/14/2008	13:50	3/14/2008	TCL-Full, TAL-Metals	30125		
WW	WW-01-02			WW	N	N	Bailer				3/14/2008	13:50	3/14/2008	Haz Waste Characteristics (ignitability, corrosivity, reactivity)			
IDW (LNAPL)																	
Example																	
FP-IDW	FP-IDW-01-02			FP	N	N	Bailer				3/15/2008	16:20	3/15/2008	TCLP and Haz Waste Characteristics (ignitability, corrosivity, reactivity)			
Fire Hydrant Water Samples																	
Example																	
FH	FH-01-02	B0F18/ MB0D49		W	N	N	Hand				12/15/2007	08:12	12/17/2007	TCL-Full, TAL-Metals	30987		
Equipment and Trip Blanks																	
Example																	
	F-1-11-03-07	B0EN9/ MB0DS9		GW	EB	N					11/3/2007	09:55	11/5/2007	TCL-Full, TAL-Metals	29935		
	T-1-11-03-07	B0ER0		GW	TB	N					11/3/2007	09:50	11/5/2007	TCL VOC	29935		

Legend:

SO	Soil sample	SD	Sediment	N	Normal media sample	TCL-full	Target compound list - volatile organic compounds, semi-volatile organic compounds, PCBs, pesticides	LNAPL	Light Non-Aqueous Phase Liquid
MS/MSD	Matrix spike and duplicate	FP	Free product	FD	Field duplicate	TCL SVOC	Target compound list - semi volatile organic compounds	TCLP	Toxicity Characteristic Leaching Procedure
SL	Sludge sample	FH	Fire hydrant	EB	Equipment blank	TAL Total Metals	Target analyte list for total metals		
GW	Groundwater sample	WW	Waste water	TB	Trip blank	VOC	Volatile Organic Compound		
SW	Surface water	IDW	Investigation Derived Waste	MSD	Matrix Spike/ Matrix Spike Duplicate	SVOC	Semi-Volatile Organic Compound		

Notes:
CLP numbers never use the letters: O, U, V, I
CLP does use numbers 1, 0

CH2MHILL

PROJECT NUMBER	BORING NUMBER
359471	SHEET OF

SOIL BORING LOG

PROJECT : Diamond Head Oil Superfund Site LOCATION: Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END : LOGGER :

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID (ppm): Breathing Zone Above Hole

Revision No. 2
Date: August 2007

CH2MHILL

PROJECT NUMBER	TEST PIT NUMBER SHEET OF

TEST PIT LOG

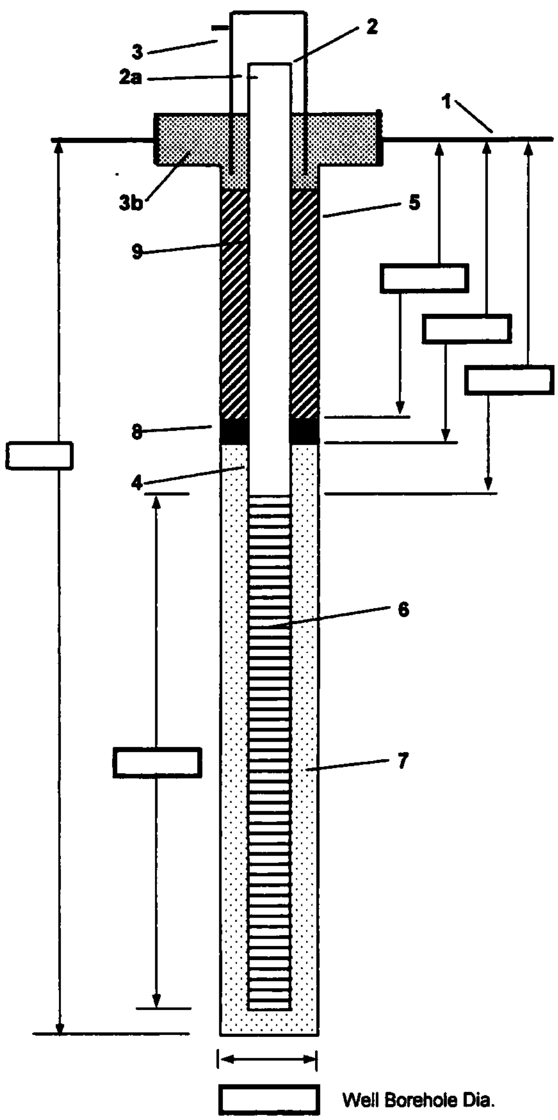
PROJECT: Diamond Head Oil Superfund Site LOCATION : Harrison Ave, Kearny, NJ 07032 (Hudson LOGGER :
ELEVATION : CONTRACTOR :
EXCAVATION EQUIPMENT USED : DATE EXCAVATED:
WATER LEVEL : APPROX. DIMENS: Length: Width: Max. Depth:

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS	
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, WATER SEEPAGE, GRADATIONAL CONTACTS, TESTS, INSTRUMENTS. PID (ppm):	Notes
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

PROJECT NUMBER	BORING NUMBER SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT Diamond Head Oil Superfund Site - Phase 2 Focused RI LOCATION: Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)
ELEVATION : Drilling Contractor:
DRILLING METHOD AND EQUIPMENT USED :
WATER LEVELS : START : END : LOGGER :



1- Ground elevation at well

2- Top of Well Casing elevation
a) vent hole?

3- Wellhead protection cover type

b) concrete pad dimensions

4- Diameter/type of well casing

5- Diameter/type of isolation casing NONE

6- Type/slot size of screen

7- Type screen filter
a) Quantity used

8- Type of seal
a) Quantity used

9- Grout
a) Grout mix used
b) Method of placement
c) Quantity of well casing grout

Development method

Development time

Estimated purge volume

Comments

Revision No. 2
Date: August 2007

[redacted]

Water Levels and LNAPL Product Thickness Measurements

Well ID No.	Date (mm/dd/yyyy)	Time (24-hr)	Top of Inner Casing Elevation (feet)	Depth to Top of Product from BTIC (feet)	Depth to Water from BTIC (feet)	Product Thickness (feet)	Water Level Elevation (feet)	Top of Product Elevation (feet)	Depth to Bottom of Well (feet bgs)	Well Bottom Elevation	Well Head PID Readings (ppm)	Comments, Product Description
MW-1												
MW-2												
MW-3												
MW-4												
MW-5												
MW-6S												
MW-7S												
MW-8S	Not Installed	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Well Not Installed
MW-9S												
MW-10S												
MW-10D												
MW-11S												
MW-11D												
MW-12S												
MW-13S												
MW-13D												
MW-14S												
MW-15S												
MW-15D												
MW-16S	Not Installed	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Well Not Installed
MW-17S												Brass Tag Stamped "MW-16D"
PZ-1												
PZ-2												
PZ-3												
PZ-4												
PZ-5												
PZ-6												
PZ-7												
PZ-8												
PZ-9												

Revision No. 1
Date: August 2007

[redacted]

Water Levels and LNAPL Product Thickness Measurements

Well ID No.	Date (mm/dd/yyyy)	Time (24-hr)	Top of Inner Casing Elevation (feet)	Depth to Top of Product from BTIC (feet)	Depth to Water from BTIC (feet)	Product Thickness (feet)	Water Level Elevation (feet)	Top of Product Elevation (feet)	Depth to Bottom of Well (feet bgs)	Well Bottom Elevation	Well Head PID Readings (ppm)	Comments, Product Description
PZ-10												
PZ-11												
PZ-12												
PZ-13												
PZ-14												
PZ-15												
PZ-16												Brass Tag Stamped "MW-8S"
PZ-17												Brass Tag Stamped "MW-16S"

Diamond Head Oil Superfund Site
LNAPL Recovery Pilot Test

Page ________ of ________

Date of Recovery Test: ______________________

Field Staff Members: ______________________

Measurement Location	Time	Depth to Product (Ft)	DTW (ft)	Product Thickness (ft)	Recovery Pump Running (Y/N)?	Time	Depth to Product (Ft)	DTW (ft)	Product Thickness (ft)	Recovery Pump Running (Y/N)?	Time	Depth to Product (Ft)	DTW (ft)	Product Thickness (ft)	Recovery Pump Running (Y/N)?
MW-3															
PZ-1															
PZ-2															
PZ-3															
PZ-4															
PZ-5															
PZ-6															
PZ-7															
PZ-8															
PZ-9															
PZ-10															
PZ-11															
PZ-12															

Time															
Vol. LNAPL Purged (gal)															

Type of Recovery Pump in use: ______________________________

Revision No. 1
Date: AUgust 2007

Diamond Head Oil Superfund Site
Air/Bio Data Sheet

Date:
Page: 1 of 3

Temp. Piez. ID	Time (24 hr)	DTW (ft BTOC)	D.O. (mg/l)	D.O. (%)	Conductivity (mS/cm)	pH (std. unit)	O.R.P (mV)	Temp (˚C)

Diamond Head Oil Superfund Site
Air/Bio Data Sheet

Date:

Date	Time	A/S System Running?	Ambient Temperature (°F)	Barometric Pressure (mm HG)	Weather	Influent Temperature (°F)	Effluent Temperature (°F)	Bleed Flow (SCFM)	Total Flow (SCFM)	Influent Pressure (psi)	Effluent Pressure (psi)	Well Head #1	Pressure (psi)	Flow (SCFM)	Well Head #2	Pressure (psi)	Flow (SCFM)

Comments:

Revision No. 1
Date: August 2007

Date:

Well ID	A/S Running?	Time	Air Sparge Vapor Parameters					
			C02	CH4	O2	LEL	PID	FID

Well ID	A/S Running?	Time	Air Sparge Vapor Parameters					
			C02	CH4	O2	LEL	PID	FID

Well ID	A/S Running?	Time	Air Sparge Vapor Parameters					
			C02	CH4	O2	LEL	PID	FID

Diamond Head Oil Superfund Site
Respiration Test Data Sheet

Sampled By: ______________________________

			Groundwater		Soil Gas		
Well ID	Date	Time (24 hr)	D.O. (mg/l)	D.O. (%)	Pressure (inches H_2O)	O_2 (%)	LEL (%)
PZ-16							
PZ-16							
PZ-16							
PZ-16							
PZ-16							
PZ-16							
PZ-16							
PZ-16							
PZ-16							
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PZ-16							
PZ-16							
PZ-16							
PZ-16							

Diamond Head Oil Superfund Site
Low-Flow Groundwater Sampling: Field Data Sheet

Well Number:		**Site:** Diamond Head Oil Superfund Site / Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)			
Field Crew:		**Date:**	**Project #:** 359471		
Well Depth (ft.):	Purge Methodology:	Diameter	Gal. Per Foot	Diameter	Gal. Per Foot
DTW (ft.):		2"	.163	5"	1.020
Water Column (ft.):	Submersible Pump	3"	.367	6"	1.469
Well Diameter (in.):		4"	.653	8"	2.611
Gal. per ft.:	Water Quality Meter:				
Well Volume (gal.):	Horiba U-22 w/ flow cell				
Depth of Screen (ft.):					

Field Parameters

	Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
	Stabilization	< 0.3'	Purge at 200-500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%	
Initial											
1 VOL.											
2 VOL.											
3 VOL.											
4 VOL.											
5 VOL.											
6 VOL.											
7 VOL.											
8 VOL.											
9 VOL.											
10 VOL.											
Post-Purge											

Remarks: Pump Intake Depth: Control Box Setting (Hz): Development: Sampling: (Sample at 100-250 ml/min)

SAMPLING

Depth to Water Before Sampling:	
Sample Methodology:	
Sample Name:	QC Sample:
Sample Date/Time:	
Sampler / Signature:	
Filtered Metals Collected: Y / N Filter Size:	
Sample Observations:	
Parameters:	

Diamond Head Oil Superfund Site
DAILY EQUIPMENT CALIBRATION RECORD SHEET

EMPLOYEE: ____________________ LOCATION: Diamond Head Office Trailer
DATE: ____________________ PROJECT NO.: 359471

WEATHER: ____________________

PHOTOIONIZATION DETECTOR (PID)

INSTRUMENT MODEL: ______ MINI RAE 2000 ______ MINI RAE ______ OVM 580B ______ OTHER

RENTAL CO.: ______
MODEL NO.: ______
SERIAL NO.: ______

LAMP TYPE: 11.7 eV
RF: 1
ALARM: 10 ppm

CALIBRATION GAS: Isobutylene CONCENTRATION: 100 ppm LOT NO.: ______ EXP. / Mfg. DATE: ______
REGULATOR: ______ LPM
TUBING CONNECTION: Direct / T-Connection / Tedlar Bag / Other: Calibration Gas Manufacturer: ______

ZERO READING: ______ PPM
CALIBRATION READING: ______ PPM
SOURCE CHECK: ______ PPM

COMMENTS: ______

COMBUSTIBLE GAS INDICATOR (CGI)

RENTAL CO.: ______
INSTRUMENT NAME: ______
MODEL NO.: ______
SERIAL NO.: ______

CALIBRATION GAS: Multi-Gas Cal Gas Mfg: ______ LOT NO.: ______ EXP. / Mfg. DATE: ______
REGULATOR: ______ LPM
TUBING CONNECTION: Direct / T-Connection / Tedlar Bag / Other:

Calibration Gas:		Calibration Results	
OXYGEN Conc:	______	OXYGEN READING:	______ %
LEL Conc:	______	LEL READING:	______ %
CO Conc:	______	CO READING:	______ %
H2S Conc:	______	H2S READING:	______ %

COMMENTS: ______

Diamond Head Oil Superfund Site

DAILY EQUIPMENT CALIBRATION RECORD SHEET

EMPLOYEE: ____________________ **LOCATION:** Diamond Head Office Trailer

DATE: ____________________ **PROJECT NO.:** 3594714

WEATHER: ____________________

HORIBA U-22

RENTAL CO.: ____________________ **CALIBRATION SOLUTION MFR.:** ____________________

MODEL NO.: ____________________ **CALIBRATION SOLUTION LOT NO.:** ____________________

SERIAL NO.: ____________________ **CALIBRATION SOLUTION EXP. / MFG. DATE:** ____________________

CALIBRATION PROCEDURE: AutoCalibrate

pH:	Reading		Units	Std. Units	Standard	4.0 Std. Units
Conductivity	Reading		Units		Standard	4.49 mS/cm
Turbidity:	Reading		Units	NTU	Standard	0.0 NTU
Temperature:	Reading		Units	°C	Standard	N/A
Dissolved Oxygen:	Reading		Units	mg/L	Standard	20.9 mg/L (Ambient Air)
ORP:	Reading		Units	mV	Standard	N/A

COMMENTS: ____________________

CALIBRATION OK: **Y / N**

HORIBA U-10

RENTAL CO.: ____________________ **CALIBRATION SOLUTION MFR.:** ____________________

MODEL NO.: ____________________ **CALIBRATION SOLUTION LOT NO.:** ____________________

SERIAL NO.: ____________________ **CALIBRATION SOLUTION EXP. / MFG. DATE:** ____________________

CALIBRATION PROCEDURE: AutoCalibrate

pH:	Reading		Units	Std. Units	Standard	4.0 Std. Units
Conductivity	Reading		Units		Standard	4.49 mS/cm
Turbidity:	Reading		Units	NTU	Standard	0.0 NTU
Temperature:	Reading		Units	°C	Standard	N/A
Dissolved Oxygen:	Reading		Units	mg/L	Standard	20.9 mg/l (Ambient Air)

COMMENTS: ____________________

CALIBRATION OK: **Y / N**

Diamond Head Oil Superfund Site
Road Construction Record

Road designation	Documentation point (sequential number)	GPS Coordinates	Photograph after grading	Width (ft)	Photograph after geotextile placement	Photograph after stone placement	Thickness of stone inches	Width ft	Comments

Diamond Head Oil Superfund Site
Landfill Trenching Record

Trench *(east/west)*	Segment (sequential number) *(LTR-W-01)*	GPS Coordinates (segment boundaries)	Length (ft)	Width (ft)	Depth (ft)	Staining (Y / N)	Sample collected (Y / N)	Min required photos taken (2 sides, bottom, spoils, wide-angle)	Comments

Diamond Head Oil Superfund Site

Laser Induced Fluorescence (LIF) Daily Summary

CH2M HILL / TBD

DATE:

Boring ID	Date	Time	Terminal Depth (Feet bgs)	Max. Fluo. (%)	Max Fluo. Depth (Feet bgs)	Comments

Technicians: TBD

Address, phone number, web address: TBD

Revision No. 1
Date: August 2007

Diamond Head Oil Superfund Site

Daily Activity Summary

Project: Diamond Head Oil Superfund Site, Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)

Date: **Project #:** 359471

Weather:

I. CH2M HILL Field Staff:

II. Equipment on site:

A.

B.

C.

D.

III. Personnel on site:

A.

B.

C.

D.

IV. Activities Conducted (Including sample and LIF locations and name):

1)

2)

3)

4)

5)

6)

7)

8)

9)

10)

VIII. Comments (standby time, down time, visitors, other site activity, etc.):

Inspected by:

CH2M HILL New Jersey Office	Diamond Head Oil Superfund Site Daily Construction Report (ATTACH ADDITIONAL SHEETS IF NECESSARY)	DATE OF REPORT:	
		REVISION NO: 00	
		REVISION DATE:	

Task:	Project Location:		REPORT NO:	
PROJECT NO:	SUPERINTENDENT:	SITE H&S SPECIALIST:		
AM WEATHER: .	PM WEATHER:.	MAX TEMP:	MIN TEMP:	Precipitation:

Work Performed Today

Type and Results of Inspection: (include Satisfactory Work Completed or Deficiencies with Action to be taken).

List Type and Location of Tests Performed and Results of These Tests:

Verbal Instructions Received:

Corrective Actions Proposed/Taken:

Remarks:

Safety Violations Observed:

JOB SAFETY					
	Was A Job Safety Meeting Held This Date?	☐ Yes	☐ No	TOTAL WORK HOURS ON JOB SITE THIS DATE (Including Continuation Sheets)	
	Were there any lost-time accidents this date? (If Yes, attach copy of completed OSHA report)	☐ Yes	☐ No	CH2MHILL On-Site Hours	
	Was a Confined Space Entry Permit Administered This Date? (If Yes, attach copy of each permit)	☐ Yes	☐ No	Subcontractor On-Site Hours	
	Was Crane/Man lift/Trenching/Scaffold/HV Elec/High Work/Hazmat Work Done? (If so, attach statement of inspections performed)	☐ Yes	☐ No	Other Subcontractor On-Site Hours	
				Total On-Site Hours This Date	
	Was Hazardous Material/Waste Released into the Environment? (If Yes, attach description of incident and proposed action)	☐ Yes	☐ No	Cumulative Total of Work Hours From Previous Report	
				Total Work Hours From Start of Construction	

SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED (Include Safety Violations, Corrective Instructions Given, Corrective Actions Taken, and Results of Safety Inspections Conducted): See "Work Performed Today" section above.

LIST OF ATTACHMENTS (OSHA Report, Confined Space Entry permit, Incident Reports, etc.):

EQUIPMENT and/or MATERIAL RECEIVED TODAY TO BE INCORPORATED IN JOB				
DESCRIPTION OF EQUIPMENT/MATL RCVD	MAKE/MODEL/MFR.	EQUIPMENT/ LOT NO.	INSPECTED BY	NO/ VOL/ WT

EQUIPMENT and/or MACHINERY USED TODAY					
DESCRIPTION	LOCATION	RENTAL PERIOD/STATUS	USED	IDLE	REPAIR

WORK PERFORMED TODAY					
EMPLOYEE	WORK PERFORMED	EMPLOYER	EMPLOYEE #	TITLE/TRADE	HRS
CH2M HILL Personnel					
				Total	
Subcontractor Personnel					
				Total	
Others					
				Total	
INCLUDE ALL PERSONNEL WORK HOURS IN THE TOTAL WORK HOURS ON JOB SITE					

SAFETY REQUIREMENTS HAVE BEEN MET			SUPERINTENDENT'S SIGNATURE		DATE
☐ Yes	☐ No				

Diamond Head Oil Superfund Site
Field Change Request (FCR) Form

Project Name: Diamond Head Oil Superfund Site **Request Number:** FCR-

Field Change Request Title: ______________________________

To: ______________________________

Date: ______________________________

Description:

Reason for Change:

Recommended Disposition

Field Team Leader (or designee): ______________________________

Signature Date

Disposition:

Project Manager: ______________________________

Signature Date

Approval USACE Project Manager: ______________________________

Signature Date

Distribution:
EPA Project Manager
Project QA Officer
CH2M HILL Project Manager
Field Operations Lead

Other:

Revision No. 1
Date: August 2007

Staff Sign-In

Diamond Head Oil Site Phase 2 Focused RI/FS
Kearny, Hudson County, New Jersey, 07032-4310

Name (Print Legibly)	Affiliation	Date	Time Arrived at Site	Time Departed from Site	Purpose of Visit / Comments
John Doe	CH2M HILL	10/1/2007	0700	1700	Landfill Evaluation

Revsion No. 1
Date: August 2007

Visitor Sign-In

Diamond Head Oil Site Phase 2 Focused RI/FS
Kearny, Hudson County, New Jersey, 07032-4310

Name (Print Legibly)	Affiliation	Date	Time Arrived at Site	Time Departed from Site	Purpose of Visit
John Doe	USEPA	10/1/07	0900	1405	Site Visit

Rental Equipment Tracking Log
Diamond Head Oil Site Phase 2 Focused RI/FS,
Kearny, Hudson County, New Jersey, 07032-4310

Equipment Type	Owner	I.D. #	Replaces Unit #	Date Received	Date Returned	Reason Returned
OVM 580B	Pine Environmental	C-1000	Original Unit	11/1/2007	11/31/2007	Dead Battery
OVM 580B	Pine Environmental	C-1001	C-1000	11/31/2007		

Diamond Head Oil Superfund Site
Investigation Derived Waste (IDW)
DRUM LOG

Drum Number	Start Date	End Date	% FULL	% WATER	% SOLID	Comments

Paage ____________

STANDARD OPERATING PROCEDURE
SAMPLE COLLECTION, BOTTLE, AND PRESERVATION REQUIREMENTS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for selecting appropriate sample containers and preservation methods for environmental samples collected for chemical analysis.

2.0 Materials

a. Laboratory pre-preserved sample containers
b. Dry Ice
c. Ice
d. pH paper
e. Safety glasses
f. Chain of Custody Forms
g. Sample packing supplies (vermiculite, ziplock bags, tape)
h. Sample coolers

3.0 Procedure

Bottle Requirements

3.1 In general, if the analyte is organic (TCL, TCLP, SPLP, and bacterial count), the container will be made of glass. If the analyte is inorganic, then the container will be HDPE plastic. Separate samples will be taken when both organic and inorganic analysis are required. Containers will be kept in the dark in coolers (to minimize biological or photooxidation/photolysis breakdown of constituents) until they reach the analytical laboratory. The sample container should allow approximately 10% air space ("ullage") to allow for expansion/vaporization if the sample is heated during transport (1 liter of water at 4°C expands by 15 mL if heated to 130°F/55°C). Headspace is not allowed for sample containers used for VOC analysis.

3.2 For intact core soil samples, cores will be collected within an acetate MacroCore sleeve. The acetate sleeves will not be cut open for observation but instead will immediately be packed, capped, and flash-frozen with dry ice.

3.3 Once a sample bottle has been opened, the containers must be used immediately for the storage of a particular sample. Unused, but opened containers are to be considered contaminated and must be discarded;

because of the potential for introducing a contaminant, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or missing Teflon liners (if required for that container) are to be discarded.

When sample containers are stored on site, the containers will be stored sealed and as far as possible from the solvents also being stored. Ideally, solvents should be kept in separate facilities from the containers and blank water.

Sample container, sample volume, and sample preservation requirements (for aqueous samples only) are listed in the attached table.

3.4 For organic and cyanide samples, wet ice will be used to maintain the internal cooler temperature at 4°±2°C.

Preservation Requirements

3.5 For **intact core soil samples**, no chemical preservative will be required. Intact cores will be collected within an acetate MacroCore sleeve. Each sample will immediately be packed, capped, and flash-frozen with dry ice.

3.6 Groundwater samples collected for **LNAPL/Groundwater Fluid Properties Tests** and **bacterial counts** require no chemical preservatives.

3.7 Soil samples collected for **SPLP VOC & SVOC** analysis require no chemical preservatives.

3.8 LNAPL samples for **TCLP and hazardous waste characteristics** analyses require no chemical preservatives.

Procedures for chemical preservation of aqueous samples for **organic (TCL) analyses** are described below:

1. Samples to be analyzed for organic (TCL) will be preserved by the addition of the correct volume (approximately 0.25 ml) of 1:1 Hydrochloric Acid (HCl) to reduce the pH to less or equal to 2 standard units. Pre-preserved bottles will be used. Visually inspect all vials to ensure that the amount of preservative used is approximately the same.

2. Check the pH of samples collected in pre-preserved bottles at the frequency of once per day. For this purpose, collect an extra sample container for pH determination and test before the actual sample is collected for laboratory analysis. Use a pH meter or pH paper. The

pH meter or paper must never be put directly into a sample container collected for laboratory analysis in order to avoid contamination from entering the sample. The pH testing will determine the additional volume (i.e., number of drops), if any, of preservative needed to lower the pH of the sample to less than or equal to 2 standard units.

3. Add the additional number of drops determined to be needed to all organic samples from a well.

4. Once the need for additional preservative is identified at a location, test the pH of the remaining samples collected at that location. Retest the pH at the next sampling location. As long as the pH does not indicate the need for additional preservative, continue to test the pH at the rate of once per day.

5. Add any additional preservative determined to be needed in the field, to the sample bottle from a dispenser container before the sample is added to the bottle.

6. Following sample collection in the pre-preserved bottle, cap and <u>gently</u> agitate the sample bottle in order to homogenize the preservative throughout the sample and to ensure that no air bubbles are present.

7. If air bubbles are present, discard the sample container and prepare a new container.

8. Failure to chemically preserve the aqueous VOC sample fraction will reduce the holding time to 7 days.

Procedures for chemical preservation of aqueous samples for **TAL (metals)** analysis are described below:

1. Samples to be analyzed for TCL (Metals) will be preserved by the addition of the correct volume (approximately 5 ml) of 1:1 Nitric Acid (HNO_3) to reduce the pH to less or equal to 2 standard units. Pre-preserved bottles will be used. Visually inspect all bottles to ensure that the amount of preservative used is approximately the same.

2. Check the pH of samples collected in pre-preserved bottles at the frequency of once per day. For this purpose, collect an extra sample container for pH determination and test before the actual sample is collected for laboratory analysis. Use a pH meter or pH paper. The pH meter or paper must never be put directly into a sample bottle collected for laboratory analysis in order to avoid contamination from entering the sample. The pH testing will determine the additional

volume (i.e., number of drops), if any, of preservative needed to lower the pH of the sample to less than or equal to 2 standard units.

3. Add the additional number of drops determined to be needed to all samples collected from a well.

4. Once the need for additional preservative is identified at a location, test the pH of the remaining samples collected at that location. Retest the pH at the next sampling location. As long as the pH does not indicate the need for additional preservative, continue to test the pH at the rate of once per day.

5. Any additional preservative determined to be needed in the field, will be added to the sample bottle from a dispenser container before the sample is added to the bottle.

6. Following collection of the sample in the pre-preserved bottle, the bottle will be capped and gently agitated in order to homogenize the preservative throughout the sample.

Note: If acidification causes effervescence, the sample should be submitted without preservation except for cooling to 4°±2°C. The effervescence should be noted in the field logbook and the Chain-of-Custody form.

Sample Collection Procedures

3.7 **Groundwater samples** will be collected in the order of decreasing compound volatility. Field indicator parameters will be collected through an in-line flow-through cell while the well is being purged. Upon stabilization of the indicator parameters, the flow-through cell will be disconnected and groundwater samples collected directly from the pump discharge tubing. The groundwater samples will be collected in the following order: TCL VOCs followed by all other organics on the TCL list (SVOC, Pesticides, PCBs), TAL metals (total), TAL metals (dissolved).

3.8 Samples for TCL VOC analyses must be collected by filling the sample vials in a manner that will minimize water agitation and therefore, loss of VOCs during sampling. Fill the vial slowly until the water forms a positive meniscus at the brim. Replace the cap by gently setting it on the water meniscus. Tighten firmly, invert the vial, and tap it lightly. If air bubbles are present in the sample, use another vial to collect another sample. Place samples in a cooler with sufficient bagged ice to cool the samples to 4°C immediately upon collection.

3.9 Proceed with filling the bottles for the remaining TCL organics and TAL total metals analyses.

3.10 **Intact core soil samples** will be collected during LIF delineation within an acetate sleeve. The sleeves will not be cut open for observation but immediately packed, capped, and flash frozen with dry ice. Only soils with 75% recovery will be acceptable for shipment to the laboratory for analysis. Procedures for LIF intact core sampling are presented in the *LIF Delineation and Confirmatory Sampling* SOP.

3.11 **Soil samples** will be collected during the landfill investigation via two trench pits. Specific sampling procedures are described in the *Sampling of Soil During Landfill Trenching, Sampling of Soil During Landfill Trenching* SOP, and the *Collection of Soil Samples for VOC* SOP.

3.12 **LNAPL samples** will be collected in accordance to the *LNAPL sampling during LNAPL Recovery and LIF Characterization* SOP

3.13 **IDW and Fire Hydrant samples** will be collected in accordance to the *Sampling of Liquid IDW and Fire Hydrant* SOP.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Fill vials for VOC analyses slowly and check for bubbles.
Personnel should wear the appropriate personal protective equipment when handling preservatives and environmental samples.

6.0 References

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater. 15th Edition. APHA, Washington, DC.

USEPA, 1984. Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act. Federal Register, Vol. 49 (209), Oct. 26, 1984, p. 43234.

USEPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020. USEPA-EMSL, Cincinnati, OH.

USEPA. Introduction to the CLP, EPA540-R-99-004, OSWER 9240.0-34P, February 2000.

USEPA. CLP Guidance for Field Samplers, EPA 540-R-00-003, OSWER 9240.0-35, Draft Final, June 2001.

7.0 Attachments

The table attached to this SOP summarizes the analytical program including sample bottle, preservation, and holding time requirements.

Table 1
Summary of Analytical Program
Diamond Head Oil Superfund Site

Media sampled	Sample Category	Analyses	Analytical Method	Laboratory performing analysis	Bottleware Requirement	Number of containers per sample	Preservation	Estimated No. of Samples (excluding QA/QC)	No. of Analysis per Sample	Amount of Preservative	Sample Holding Time
Soil	Soil (saturated zone sample)	Fluid Saturation Evaluation: LNAPL & water saturation(%), total porosity, air-filled porosity, dry bulk density, grain density	ASTM RP40	Specialty Subcontracted lab (PTS)	Intact acetate MacroCore Sampler Sleeve	1 - 5' Core	Cryogenic-Freezing w/ Dry Ice	1	10	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Drainage Capillary Pressure Test	ASTM D6836 API RP40						1	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Grain Size analysis	ASTM D422/4464						2	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Total organic carbon	Walkley-Black						2	NA	No holding Time - 28 days guideline
		Free Product mobility (centrifuge method) three pressure set points, two samples per core)	Modified ASTM D425						6	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Photolog Digital Core - Full-Scale: white light and UV (per 2 foot section)	ASTM D5079 API RP40						2	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
Soil	Soil (moderate saturated zone sample)	Fluid Saturation Evaluation: LNAPL & water saturation(%), total porosity, air-filled porosity, dry bulk density, grain density	ASTM RP40	Specialty Subcontracted lab (PTS)	Intact acetate MacroCore Sampler Sleeve	1 - 4' Core	Cryogenic-Freezing w/ Dry Ice	1	8	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Drainage Capillary Pressure Test	ASTM D6836 API RP40						1	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Grain Size analysis	ASTM D422/4464						2	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Total organic carbon	Walkley-Black						2	NA	No holding Time - 28 days guideline
		Free Product mobility (centrifuge method) three pressure set points, two samples per core)	Modified ASTM D425						6	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Photolog Digital Core - Full-Scale: white light and UV (per 2 foot section)	ASTM D5079 API RP40						2	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
Soil	Soil (low saturated zone sample)	Fluid Saturation Evaluation: LNAPL & water saturation(%), total porosity, air-filled porosity, dry bulk density, grain density	ASTM RP40	Specialty Subcontracted lab (PTS)	Intact acetate MacroCore Sampler Sleeve	1 - 3' Core	Cryogenic-Freezing w/ Dry Ice	1	6	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Drainage Capillary Pressure Test	ASTM D6836 API RP40						1	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Grain Size analysis	ASTM D422/4464						2	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Total organic carbon	Walkley-Black						2	NA	No holding Time - 28 days guideline
		Free Product mobility (centrifuge method) three pressure set points, two samples per core)	Modified ASTM D425						6	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
		Photolog Digital Core - Full-Scale: white light and UV (per 2 foot section)	ASTM D5079 API RP40						2	NA	Physical Properties Samples - No holding Time. Indefinite for cryogenically preserved samples.
Soil	SPLP Leachability	SPLP VOC	SW-846 1312/ SW-846 8260	Specialty Subcontracted lab (CVO)	8 oz glass	1	Cool to 4 C	4	1	NA	7 Days
		SPLP SVOC	SW-846 1312/ SW-846 8270	Specialty Subcontracted lab (CVO)	8 oz glass	1	Cool to 4 C	4	1	NA	7 Days to extraction/ 40 days to analysis
Soil	Soil-Landfill Investigation	TCL-VOCs	SOW SOM01	CLP	3 of 5g Encore samplers plus 1 of 2 oz. glass jar	3 + 1	Cool to 4 C	10	1		48 hours/ 40 days to analysis
		TCL-SVOCs	SOW SOM01	CLP	8oz. amber glass	1	Cool to 4 C	10	1		7 Days to extraction/ 40 days to analysis
		TCL-Pesticides/PCBs	SOW SOM01	CLP	8 oz. wide mouth clear or amber glass	1	Cool to 4 C	10	1		7 Days to extraction/ 40 days to analysis
		TAL	SOW ILM05.3	CLP	8 oz. wide mouth clear or amber glass	1	Cool to 4 C	10	1		180 Days
Groundwater	Groundwater-Air/bio Sparge evaluation	TCL-VOCs	SOW SOM01	CLP	40mL clear glass vial w/ septa	3	Cool, 4◦ C, HCl to pH<2, no headspace	10	1	0.5 mL	14 Days
Groundwater	Groundwater Specialty testing for air/bio sparge evaluation	CFU/1 mL Heterotrophic plate count	ASTM 9215B	Specialty Subcontracted Lab (Adams Laboratories)	120 ml sterile glass bottle	1	None	10	1	N/A	30 hours
LNAPL/Ground water	LNAPL/Groundwater Samples	LNAPL Fluid Properties: Dynamic viscosity, fluid density at 3 temperatures, surface tension for each fluid, interfacial tension (three phase pairs: oil/water, oil/air, water/air)	ASTM D1481 ASTM D445 ASTM D971	Specialty Subcontracted Lab (PTS)	Amber 500ml for NAPL, Clear 1 liter for groundwater	1 per fluid (2 total)	None, bottle capped	2	1	NA	Physical Properties Samples - No holding Time. Indefinite for NAPL.
LNAPL	LNAPL Chemical Characterization	TCL-VOCs	SOW SOM01	DESA / Subcontracted lab	40mL clear glass vial w/ septa	3	Cool to 4 C	1	1	NA	14 Days
		TCL-SVOCs	SOW SOM01	DESA / Subcontracted lab	8oz. amber glass	1	Cool to 4 C	1	1	NA	7 Days to extraction/ 40 days to analysis
		TCL-Pesticides/PCBs	SOW SOM01	DESA / Subcontracted lab	8 oz. wide mouth clear or amber glass	1	Cool to 4 C	1	1	NA	7 Days to extraction/ 40 days to analysis
		TAL	SOW ILM05.3	DESA / Subcontracted lab	8 oz. wide mouth clear or amber glass	1	Cool to 4 C	1	1	NA	180 Days
LNAPL	LNAPL Waste Characterization	TCLP	1311/ 8000/ 6010/7470	DESA / Subcontracted lab	2 of 8 oz clear glass	2	Cool to 4 C	1	1	NA	ASAP, No longer than 14 days
		Ignitability	1010	DESA / Subcontracted lab	8 oz clear glass	1	Cool to 4 C	1	1	NA	14 Days
		Corrosivity	9045	DESA / Subcontracted lab							
Water	Decontamination Water	TCL-VOCs	SOW SOM01	CLP	40mL clear glass vial w/ septa	3	Cool, 4◦ C, HCl to pH<2, no headspace	1	1	0.5 mL	14 Days
		TCL-SVOCs	SOW SOM01	CLP	2 of 1L amber glass	2	Cool to 4 C		1	NA	7 Days to extraction/ 40 days to analysis
		TCL-Pesticides/PCBs	SOW SOM01	CLP	2 of 1L amber glass	2	Cool to 4 C		1	NA	7 Days to extraction/ 40 days to analysis
		TAL	SOW ILM05.3	CLP	1L poly	1	HNO3 to pH<2		1	3 mL	180 Days

STANDARD OPERATING PROCEDURE
SAMPLE LABELING, PACKAGING AND SHIPPING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for the labeling, packaging and shipping of samples to the laboratory for analysis.

2.0 Materials

a. Waterproof hard plastic coolers
b. Metal paint cans
c. Sample labels from subcontracted laboratories, CLP labels, custody seals
d. Chain of custody forms from subcontracted laboratories and FORMS II Lite™ software to prepare chain of custody forms for the CLP laboratories
d. Absorbent packing material
e. Ice
f. Dry Ice
g. Clear tape
h. Clear Ziploc bags

3.0 Procedure

3.1 ***For intact core samples***: dry ice is to be added to the sample cooler prior to collecting each sample. After collecting each intact soil core sample in a MacrotubeTH, both ends of the MacrotubeTH will be immediately sealed at both ends. Each end of the Macrotube™ will be identified as either "top" or "bottom" and the sample label will be attached and taped to the Macrotube™. The core will then be placed into the cooler as quickly as possible to allow the sample to flash-freeze.

For all samples:

3.2 Ensure sample lids are tight.

3.3 Place each sample in the shipping cooler as collected.

3.3 Place the following, properly filled-out, on each CLP laboratory sample bottle: CLP sample label generated by FORMS II Lite™ software.

3.4 If laboratory sample is destined for a non-CLP laboratory, place the completed subcontracted laboratory's sample label on each bottle.

3.5 Place Custody Seal across the cap of each bottle.

3.6 Enclose each sample, properly identified and with a sealed lid, in a clear Ziploc bag (with the exception of intact core samples), and make sure that sample labels are visible. Include the temperature blank in the cooler. Temperature blanks will be labeled as "Temperature Blank" and the date of the blank will be recorded on the label.

3.8 For samples being analyzed for TCL, TAL, and TCLP add sufficient ice in cooler to maintain the internal temperature at $4^{o}\pm2^{o}C$ during transport. Double-bag and seal loose ice in Ziploc bags to prevent melting ice from soaking the packing material.

3.9 Fill cooler with enough absorbent and packing material to prevent breakage of the sample bottles and to absorb the entire volume of the liquid being shipped (off site sample shipment only).

3.10 Any samples suspected to be of medium/high concentration (including LNAPL free product samples) must be enclosed in a metal can with a sealable lid (e.g., clean paint cans). The samples should be cushioned inside the can with enough noncombustible, absorbent material (e.g., certified asbestos-free vermiculite) to prevent breakage and absorb leakage. Label the outer metal container with the sample number of the sample inside.

3.11 Samples collected which contain free product will be labeled and shipped in accordance to CH2M HILL's *Procedures for Shipping Dangerous Goods.*

3.12 Affix the Chain of Custody form to the underside of the cooler lid. If more than one cooler is being used, a unique COC must be completed for each cooler and the samples contained therein.

3.13 Seal coolers at a minimum of two locations (e.g., opposite corners of the cooler) with signed custody seals and cover the seals with clear tape.

3.14 Tape the cooler shut with strapping tape over the hinges and place tape over the cooler drain. Do not obscure the custody seals.

3.15 Attach completed shipping label to the top of the cooler using wide clear tape.

3.16 Ship all samples via priority overnight delivery within 24 hours of collection (off site sample analyses only) or transport in cooler to on-site laboratory for analysis. Insure all sample shipments up to $1,000.

4.0 Maintenance

Not Applicable.

5.0 Precautions

None.

6.0 References

USEPA. Introduction to the CLP, EPA540-R-07-02, OSWER 9240.0-42, January 2007.
USEPA. CLP Guidance for Field Samplers, EPA 540-R-07-06, OSWER 540-R-07-06, Final, July 2007.

7.0 Attachments

None

STANDARD OPERATING PROCEDURE
Laser Induced Fluorescence (LIF) Delineation and Confirmatory Soil Sampling

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for oversight of the laser induced fluorescence (LIF) survey activities for LNAPL delineation and associated confirmatory and supplemental soil sampling.

2.0 Materials

a. Field Log Book
b. Camera
c. Tape Measure
d. PID
e. Daily LIF Summary log and Daily Activity Summary log
f. Health and Safety Plan
g. Figure 2 - LIF Delineation Survey Areas
h. Subcontractor Statement of Work (SOW) for LIF Survey Investigation and Compensation Schedule

3.0 Procedure

Delineation of underground utilities in the investigation area will be performed through the New Jersey One-Call System. Request for markout and maintaining the validity of the markout will be the responsibility of the subcontractor performing the work. Confirmation "ticket" numbers for markout requests must be provided to CH2M HILL prior to commencing work. In addition, CH2M HILL will subcontract a private utility markout company to perform a surface geophysical investigation in the clover-leaf areas of I-280.

3.1 LIF Calibration Check and Site-Specific Verification

3.1.1 The LIF investigation will begin with mobilization and set-up of the Laser Induced Fluorescence equipment consisting of a direct push technology drill rig (e.g., GeoProbe or Cone Penetrometer Rig), the LIF probe tip with fiber optic data cable, and laser generator / control box / computer.

3.1.2 The subcontractor will perform initial operations and generic calibration checks including from the measurement of a "Reference Emitter" source. All subsequent data will be reported as a percentage of fluorescence reflection compared to this reference emitter or "% RE". If the %RE is not within the instrument specification, then the subcontractor will make the necessary adjustments to ensure that the equipment meets specifications prior to performing further measurements.

3.1.3 Site specific verification of the LIF equipment will also be performed. Three samples of LNAPL material will be obtained by CH2M HILL from existing monitoring wells / piezometers: MW-03S, PZ-10, and MW-13S. Discrete samples of LNAPL (approximately 500 mL) will be collected from each well using dedicated disposable bailers. The samples will be provided to the LIF subcontractor for use in determining that the LIF instrument will generate adequate %RE to meet the data needs of the investigation. The samples will be maintained throughout the duration of the LIF survey for subsequent verification and finally disposed of with other LNAPL IDW at the completion of the project.

3.1.4 Site specific reference probes will be installed for baseline understanding of the LIF data following probe calibration and verification activities to determine the in situ site specific response characteristics of the LIF in areas where elevated LNAPL saturations have been identified and where it has not been identified (e.g. clean areas).. Three LIF borings will be installed immediately adjacent to the existing monitoring wells containing LNAPL that were used to verify the instrument response (MW-03S, ,PZ-10, and MW-13S). Two additional LIF borings will be installed in areas of the site that were observed to be "clean" during the Phase 1 Investigation. These locations will be at Phase 1 borings SB-27 and SB-29 located on the north end of the site. Note that these five borings are LIF borings only without conventional soil core sampling. Instead, the LIF responses from these borings will be compared to the existing soil boring logs and analytical data obtained during Phase 1. (See discussion of peat in next bullet.)

3.1.5 During the LIF reference probing at the two clean locations, SB-27 and SB-29, the LIF will be advanced through the depth of the peat layer (based on Phase 1 boring logs) to determine the LIF %RE response in this organic rich geologic unit.

3.2 LIF Delineation Survey

3.2.1 <u>Delineation Decision Logic</u>

3.2.1 The objective of the LIF survey is to delineate the lateral and vertical extent of LNAPL including residual and potentially mobile phases.

3.2.2 As a general guideline, delineation probing will commence on a grid system with probing at 50-foot center points. The grid location and spacing will be refined in the field based on LIF response data and subject to site accessibility and underground utility constraints.

3.2.3 Probing will continue in each direction until the boundary of the area containing potentially mobile or residual LNAPL is determined.

3.2.4 Delineation will be considered achieved when probe results (i.e., the maximum %RE value) are comparable to those obtained during the site specific verification of "low" LNAPL saturations from locations SB-27 and SB-29, which are expected to be clean background locations.

3.2.5 The LIF operator will advance the probe to the terminal depth determined to be whichever condition is encountered first: A) 2-feet below the bottom of LNAPL as observed in the LIF response log, or B) the local depth of the top of the organic peat layer.

3.2.6 The approximate local depth of the peat layer, which typically occurs between 13 – 17 feet below ground, can be determined from soil boring logs collected during the Phase 1 Investigation If high LIF responses are detected near the top of the peat layer, the boring will be stopped above the peat and the FTL will contact the Investigation Task Lead and/or Project Manager. The USEPA will then be contacted to discuss the option of continuing probing through the peat layer. In the interest of time efficiency the boring may be abandoned and delineation resumed at the next location. If additional data is desired by the USEPA to close the data gap through the peat, a second boring may be advanced adjacent to the first location for the purpose of continuing through the peat unit.

3.2.2 <u>LIF Survey Oversight and Documentation</u>

3.2.2.1 CH2M HILL will indicate to the subcontractor the location in which a LIF boring should be advanced and the "not to exceed" depth at which the organic peat layer is located in this area.

3.2.2.2 The LIF operator will advance the probe to the terminal depth determined as described above.

3.2.2.3 If refusal of the probe in encountered prior to the targeted terminal depth for the boring, the probe will be re-located in the immediate vicinity (e.g., by rotating the swing-arm of the probe) and advanced again. If three consecutive refusal points are encountered, the entire rig will be moved approximately 5-feet and probing resumed.

3.2.2.4 The LIF computer software will generate a real-time, continuous, color-coded strip log of fluorescence response. Each log will be printed in the field and assembled in a field binder. The pertinent data will be recorded by CH2M HILL on the attached LIF Daily Summary log of LIF response information and the Daily LIF Summary of drilling progress.

3.2.2.5 The Subcontractor and CH2M HILL will routinely check the depth measurements given by the string potentiometer depth gauge mounted on the DPT rig and recorded by the computer. It will be checked routinely by comparison of its measurements against the summation of linear footage of probe rods being used to ensure depth measurement accuracy. If inaccuracy is found, probing will be stopped and a remedy will be implemented to ensure that all data being reported is true and accurate.

3.2.2.5 The location ID of the LIF boring will be marked on a survey pin flag and staked for future reference. The location of the boring will also be surveyed for latitude and longitude with GPS.

3.2.2.6 CH2M HILL will evaluate the response observed on the LIF log and determine if delineation has been achieved and where the next boring should be located following the 50-foot centers grid network using the decision logic specified in Section 3.2.1.

3.2.2.7 The downhole LIF equipment will be decontaminated between boring locations.

3.2.2.8 At the end of the day (or more frequently) the LIF response logs and Daily Summary logs will be scanned and e-mailed to the RI Task Lead for review and discussion with the FTL for determining the continued direction of delineation.

3.2.3 Delineation Areas

3.2.3.1 Five areas are anticipated to be included in the LIF delineation survey as shown in the attached figure and summarized in the table below.

3.2.3.2 Delineation will be based on a grid network installed on 50-foot centers but the actual number of LIF probe locations will be based on observed results and surface infrastructure restrictions.

LIF Program: Summary of Delineation Probing				
Investigation Location	**Size of Area**	**Approximate Grid Spacing & Probing Depth**	**Estimated Number of Probe Locations ****	**Estimated Total Linear Footage of LIF**
Process Area / Landfill / Wetland Area 4 (MW-3 area) / I-280 berm	4.3 acres (190,000 sq. ft.)	50-foot centers 12 ft. bgs	76	912 l.f.
Top of Soil Berm (north end of berm)	400 ft. long 0.11 acre (4,800 sq. ft.)	50-foot centers 32 ft. bgs	9	288 l.f.
Main cloverleaf triangle	1 acre (46,200 sq. ft.)	50-foot centers 12 ft. bgs	19	228 l.f.
Unwooded portion of north cloverleaf triangle	0.16 acre (7,000 sq. ft)	50-foot centers 12 ft. bgs	11	132 l.f.
East cloverleaf triangle	0.12 acre (5,400 sq. ft)	50-foot centers 12 ft. bgs	9	108 l.f.
Totals:	5.7 acres 249,080 sq. ft.		124	1,668 l.f.
NOTE: ** The number of LIF probe locations will be based on observed results and surface infrastructure restrictions.				

3.3 Soil Sampling

The supplemental LIF sampling program is described below and in the attached summary table.

Reference tables are also available in the following related SOP's:

- Sample Nomenclature SOP – Table 1
- Sample Collection, Bottle, Preservation and Filtration Requirements SOP – Exhibit 1

3.3.1 Soil Core – LIF Correlations

3.3.1.1 During the early stage of implementing the LIF survey, conventional soil core sampling will be performed at three locations to visually correlate the observed LIF response to actual subsurface conditions.

3.3.1.2 Conventional MacroCore™ samples will be collected immediately adjacent to LIF probe locations, one each in an area of high, medium, and low LIF response.

3.3.1.3 The soil cores will be visually observed for signs of LNAPL or staining, scanned with a PID instrument, logged for geologic description, and photographically logged. The log will include specific comparison of observed soil conditions compared to LIF response and depth correlation.

3.3.1.4 Unless the cores are co-located with a boring scheduled for SPLP analysis, laboratory analytical data will not be collected from the soil core / LIF correlation borings.

3.3.2 Temporary Piezometer Installation

3.3.2.1 Installed to supplement LNAPL mobility and recoverability data, used to estimate LNAPL recharge and recoverability.
3.3.2.2 A total of five temporary piezometers will be installed within areas of high, medium and low LIF response.
3.3.2.3 The locations will supplement the 12 piezometers surrounding well MW-3 and will be installed at varying distances to provide a network of monitoring points that can be used to assess LNAPL recovery.

3.3.2.4 Constructed of 1-inch diameter, Schedule 40 PVC, with 20-slot screen.
3.3.2.5 Screen length will span the entire thickness of the LNAPL smear zone as determined by the LIF response log.
3.3.2.6 The temporary piezometers will be dropped into the open boreholes and the native formation allowed to collapse around it upon extraction of the DPT casing.
3.3.2.7 The piezometers will be allowed to stabilize. Daily / weekly LNAPL thickness measurements will be collected to evaluate stabilization.
3.3.2.8 The final LNAPL thickness will be recorded and correlated to the LIF response.
3.3.2.9 The piezometers will be extracted and the boreholes properly abandoned upon completion of the data analysis.

3.3.3 Intact Core Sampling

3.3.3.1 A series of soil cores will be collected, frozen, and shipped intact (preserving in-situ solid and fluid conditions as best possible) to a subcontracted lab to perform specialty analysis to characterize the LNAPL properties.
3.3.3.2 Soil core samples will be collected from three locations throughout the extent of LNAPL based on LIF results, one each in an area of high LNAPL saturation, moderate LNAPL saturation, and low LNAPL saturation (e.g., next to a well/piezometer with only a sheen of product). These soil core samples will also be correlated with the LIF results and groundwater/LNAPL fluid samples described below.
3.3.3.3 Intact cores will be collected within a 3-inch diameter acetate MacroCore™ sleeve extending from a depth of 1 foot above the LNAPL smear in the vadose zone to 2 feet below the LNAPL smear in the saturated zone (estimated total of 5 feet of core at the high saturation location, 4 feet of core at the moderate saturation location, and 3 feet of core at the low saturation location).

3.3.3.4 The acetate sleeves will not be cut open for observation but instead will immediately be end-packed with plastic wrap, capped, taped tightly closed, and flash-frozen with dry ice to "lock" the pore fluids and soil grains and LNAPL in place.

3.3.3.5 The cores will be shipped overnight packed in dry ice to a specialty lab for LNAPL mobility and recoverability evaluation. See the attached procedures detailing the packing and shipping procedures.

3.3.3.6 Only soil cores with greater than 75% recovery will be acceptable. If less recovery is achieved, the core will be re-attempted at an immediately adjacent boring. If adequate recovery is not achieved with two additional attempts, the location will be abandoned and sampling will progress to the next location.

3.3.3.8 Analysis at each core, in the order of performance, will consist of:

- photography for core screening and sub-sample identification
- Pore Fluid Saturation (PFS) analysis (LNAPL and water saturation [%], total porosity, air-filled porosity, dry bulk density, and grain density)
- Drainage Capillary Pressure Test
- Two Free Product Mobility (centrifuge method) tests - one from the vadose zone and one from the saturated zone.
- Two grain size analyses
- Two total organic carbon analyses

3.3.4 <u>Synthetic Precipitation Leaching Procedure (SPLP)</u>

3.3.4.1 Soil grab samples will be collected from core samples for analysis for synthetic precipitation leaching procedure, a lab procedure that simulates rainfall infiltration and contaminant leaching or groundwater contact with soil that is submerged.

3.3.4.2 Four SPLP tests will be performed; each test will be analyzed for VOC and SVOC.

3.3.4.3 The soil cores will be collected adjacent to existing wells/piezometers at depths equivalent to historic soil VOC samples from the Phase 1 investigation and/or maximum LIF detections so that the SPLP data can be compared to Phase 1 data and/or locations of highest potential concentrations. The historic sampling depths will be obtained from Phase 1 soil boring logs.

3.3.4.4 The locations of these borings will be selected based on the Phase 1 results and finalized in the field based on the LIF results.

3.3.4.5 SPLP is a grab sample procedure without homogenization.

3.3.5 <u>LNAPL / Groundwater Sampling</u>

3.3.5.1 In addition to the soil cores, groundwater and LNAPL samples will be collected for laboratory evaluation of the fluid properties.

3.3.5.2 Two sets of groundwater/LNAPL samples will be collected.

3.3.5.3 Each sample set consists of a sample from a monitoring well of LNAPL and groundwater, bottled separately but given the same sample Location ID name

3.3.5.4 The sample locations will be from existing monitoring wells / piezometers at locations within the LNAPL plume and near the intact soil core sampling locations.

3.3.5.5 The samples will be collected with disposable bailers or peristaltic pump such that the LNAPL sample is free of water and the water sample is free of LNAPL. A shroud system may be required to collect a clear sample of groundwater.

3.3.5.6 The sample pairs will be analyzed for an LNAPL Fluid Properties Analysis package consisting of: dynamic viscosity, fluid density at three temperatures, surface tension for each fluid, and interfacial tension (three phase pairs; oil/water, oil/air, and water/air).

The table below summarizes the associated LIF soil sampling.

LIF Program: Summary of Sample Analysis			
Sample Type	**Number of Sample Locations**	**Analysis Type & Frequency**	**Total number of Analysis to be Performed**
Temporary Piezometer Wells for LNAPL measurements	5 Locations: High, Medium, Low Response Areas	Periodic (e.g., daily) measurements of LNAPL thickness. Correlate thickness with LIF response	Daily measurements
LIF Correlation Cores	3 Locations: High, Medium, Low Response Areas	Visual observation and photographic Logging PID screening	3 sets of observations
Intact Core Sampling	3 soil boring locations: High LNAPL Saturation (5-foot core) Medium LNAPL Saturation (4-foot core) Low LNAPL Saturation (3-foot core)	Pore Fluid Saturation: (every six inches of core) LNAPL and water saturation[%], Total porosity, Air-filled porosity, Dry bulk density, Grain density	24 of each analysis
		Core Photography	7 photos (assuming 2-foot photo segments)
		Drainage Capillary Pressure Test (one per core at locations selected by PTS lab based on observations and reported in the data package) {at maximum LNAPL saturation}	3 capillary pressure tests
		Free Product Mobility (centrifuge method) (three pressure set points, two samples per core at locations selected by PTS lab based on observations and reported in the data package)	18 tests
		Grain size analysis (two per core at locations selected by PTS lab based on observations and reported in the data package)	6 grain size tests
		Total organic carbon (two per core at locations selected by PTS lab based on observations and reported in the data package)	6 TOC tests
SPLP Leachability	4 soil boring locations: Adjacent to wells/piezometers and at depths selected based on	Synthetic Precipitation Leaching Procedure (SPLP) for VOC & SVOC analysis (one per core with depth selected based on Phase 1 soil results and refined based on the LIF results)	4 SPLP (VOC & SVOC)

LIF Program: Summary of Sample Analysis			
	the Phase 1 soil results and refined based on the LIF results		
LNAPL / Groundwater Samples	2 monitoring well locations: Near soil core locations	<u>LNAPL Fluid Properties</u> (per LNAPL/water sample pair) Dynamic viscosity, Fluid density at three temperatures, Surface tension for each fluid, Interfacial tension (three phase pairs: oil/water, oil/air, water/air)	2 of each analysis

4.0 Maintenance

Not Applicable.

5.0 Precautions

- Intact soil core samples must have 75% recovery or greater.
- Dry ice shipping of intact soil cores requires dangerous goods handling procedures.

6.0 References

- Figure – Aerial Photograph Showing Approximate Location of Historic Oil Source Area and Layout of LIF Delineation Survey
- Phase 1 Investigation soil boring logs.
- Sample Nomenclature SOP – Table 1
- Sample Collection, Bottle, Preservation and Filtration Requirements SOP – Exhibit 1
- Subcontract SOW and Compensation Schedule

7.0 Attachments

- Packing and shipping procedures for dry-ice flash freezing of intact soil cores.
- Field forms required for this activity have been attached to this SOP.

Diamond Head Oil Superfund Site

Laser Induced Fluorescence (LIF) Daily Summary

CH2M HILL / TBD

DATE:

Boring ID	Date	Time	Terminal Depth (Feet bgs)	Max. Fluo. (%)	Max Fluo. Depth (Feet bgs)	Comments

Technicians: TBD

Address, phone number, web address: TBD

Diamond Head Oil Superfund Site
Daily Activity Summary

Project: Diamond Head Oil Superfund Site, Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)

Date:

Project #: 359471

Weather:

I. CH2M HILL Field Staff:

II. Equipment on site:

A.

B.

C.

D.

III. Personnel on site:

A.

B.

C.

D.

IV. Activities Conducted (Including sample and LIF locations and name):

1)

2)

3)

4)

5)

6)

7)

8)

9)

10)

VIII. Comments (standby time, down time, visitors, other site activity, etc.):

Inspected by:

STANDARD OPERATING PROCEDURE
LNAPL Recovery Testing

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for the operation of the LNAPL recovery test to be conducted during the Phase 2 Focused Remedial Investigation at the Diamond Head Superfund Site located in Kearny, New Jersey.

An LNAPL recoverability test will be implemented to develop design criteria and assist in the evaluation of fluid recovery technologies that may be used to remove the mobile-LNAPL. The recoverability test procedures presented in this SOP are based on procedures from the American Petroleum Industry (API).

The specific objectives of this investigation are to:

- Estimate the range of LNAPL transmissivity and recoverability present across areas of high, medium, and low LIF response and variable in-well LNAPL thicknesses
- Provide a second line of evidence (in addition to laboratory LNAPL mobility evaluation) for predicting LNAPL recovery rates from various fluid recovery technologies.

The results of the data analysis will be used as a basis for the Focused Feasibility Study to assist screening, conceptual design, and cost estimating of various LNAPL fluid recovery remedial technologies.

2.0 Materials

a. Water level meter and oil-water interface probe
b. Peristaltic pump and tubing
c. Weighted Bailer
b. Free phase petroleum pumping system
c. Plastic sheeting
d. Four pressure transducers (In-Situ Troll or equivalent)
e. Electric generator
f. PPE: Nitrile gloves, poly-coated Tyvek, and safety glasses
g. Field Book
h. LNAPL Recovery logs
i. Water Level and LNAPL Data Log sheets
j. Health and Safety Plan

3.0 Procedure

Pre-Test Data Collection:

3.1 During the early mobilization phase of the project, an initial evaluation of the LNAPL will be made from existing monitor well MW-3 and the surrounding piezometers. This evaluation will help in determining the design criteria for the full LNAPL recovery testing to be performed later in the investigation.

3.2 Baseline depth to water (DTW) and depth to product (DTP) measurements will be collected from 15 shallow monitoring wells above the peat layer ("S" designated wells), 4 shallow monitoring wells below the peat layer ("D" designated wells), and 17 piezometers.

- *Shallow monitoring wells above the peat layer*: MW-1, MW-2, MW-3, MW-4, MW-5, MW-6S, MW-7S, MW-9S, MW-10S, MW-11S, MW-12S, MW-13S, MW-14S, MW-15S, MW-17S (*note that wells MW-8S and MW-16S were never installed*)
- *Shallow monitoring wells below the peat layer*: MW-10D, MW-11D, MW-13D, MW-15D
- *Piezometers*: PZ-1, PZ-2, PZ-3, PZ-4, PZ-5, PZ-6, PZ-7, PZ-8, PZ-9, PZ-10, PZ-11, PZ-12, PZ-13, PZ-14, PZ-15, PZ-16, PZ-17

3.2.1 Collection of DTW and DTP measurements will follow the procedures described in the SOP for *Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers*. Data collected during this synoptic event will be recorded in the attached WL and LNAPL Data Log sheets.

3.3 A temporary IDW staging area will be created near MW-3. Plastic sheeting will be placed around MW-3 and will be spread out throughout the temporary staging area to minimize cross-contamination. Two empty 55-gallon drums will be temporarily staged close to MW-3 for collection of LNAPL that is recovered during the test. All IDW drums will be labeled in accordance with the Site Management Plan.

3.4 The LNAPL recovery pre-test will begin with an LNAPL bail down test. The information gathered during this pre-test will be used to asses the suitability of well MW-3 and the surrounding piezometers, develop pumping equipment specifications, and determine the anticipated duration of LNAPL recovery tests.

3.5 During the pre-test, tubing will be lowered into the layer of LNAPL above the water table in MW-3. A peristaltic pump will then be connected to the tubing and LNAPL will be purged rapidly from the well into nearby IDW drums. The pump tubing may need to be larger diameter, such as 3/8-inch or ½-inch inside diameter, to accommodate the viscosity of the

LNAPL. In addition to the peristaltic pump, a bailer will simultaneously be used to purge LNAPL from the well in order to quickly reduce the thickness of the LNAPL. Care should be taken to remove only LNAPL from the well.

3.6 Once at least 80% of the original LNAPL thickness has been removed from the well, pumping will cease and the well will be allowed to recharge. Recharge rate will be assessed through frequent DTW and LNAPL thickness measurements. DTW and DTP measurements and the amount of LNAPL recovery will be recorded in LNAPL Recovery logs with respect to time.

3.7 The pre test will be accomplished in one day and the LNAPL purged from the well will be containerized in the 55-gallon drum as described in the Site Management Plan. All PPE and other IDW wastes will be disposed of in accordance to the Site Management Plan.

LNAPL RECOVERY TESTING

3.8 A confirmatory round of DTW and DTP data will be collected from all wells prior to the start of the LNAPL recovery tests. This synoptic event will follow the procedures listed in Section 3.1 and will be expanded to include the five temporary peizometers (TPZ-01 through TPZ-05) installed during the LIF evaluation to supplement the LNAPL measurements.

3.9 Four pressure transducers will be installed in four separate wells. One transducer will be installed in the pumped well and three transducers will be installed in surrounding piezometers at different distances. Exact well locations will be determined by the FS Lead based on results of the pre-test.

3.10 The pressure transducers will be installed in each well following the manufacturer's instruction manual. Each transducer will be configured to collect pressure readings at linear time intervals, starting at 15 second increments, and will be adjusted for subsequent pumping tests based on observed results. Data collection will begin prior to initiating pumping and will continue through LNAPL recovery.

3.11 Manual water level and LNAPL thickness measurements will be gathered from the wells with transducers and the remaining piezometers. This data will be collected prior to and during the recovery test. Information will be recorded in LNAPL Recovery logs. Measurements collected manually will be used to calibrate transducer response in terms of depth to water and LNAPL thickness.

3.12 Measurement of LNAPL/water interface with the water level meter may be difficult as the interface probe may become coated with oil and not function properly. One solution may be the use of a section of PVC pipe

(1 or 2 inches in diameter by 8 or 10 feet long) with a thin membrane (e.g. aluminum foil, cellophane, etc.) affixed to the bottom such that the pipe can be lowered through the LNAPL and into the underlying water. The probe may be dropped from the ground surface to punch through the membrane into the water below. The PVC pipe can be extracted and the oil/water interface measured from below the oil as the probe is raised. This method may be more effective than conventional top-down measurements.

3.13 LNAPL recovery pumping will begin (at the pre-determined start time) by purging free product from a designated well. The first well will likely be MW-3, but this will be verified by the FS Lead prior to conducting the test. A pumping system will be designed based on the pre-test results and will be utilized to purge free product from the well. Pumping flow rates and the duration of pumping will be dictated by the FS Lead after analyzing the results of the LNAPL recovery pre-test. All recovered product will be containerized in 55-gallon drums in accordance to the Site Management Plan.

3.14 Once the pumping has decreased the LNAPL thickness by at least 80% of the thickness present before the test, the pump will be turned off.

3.15 LNAPL recovery monitoring will include measurement of DTW and DTP from each piezometer and well included in the study, as listed in Section 3.8. DTW and DTP measurements will be collected frequently (every ½ hour for the first 4 hours, and hourly thereafter) until at least 80% of the original product thickness in the well has recovered or for up to 8 hours, whichever occurs first. Measurements will continue into a second day, with one event conducted in the morning and one event in the afternoon, to allow the well to more fully recover from the test.

3.16 The second and third LNAPL recovery tests will be performed in wells identified by the FS Lead and as outlined in Section 3.12 to 3.14. Each of three LNAPL recovery tests should be separated by at least one full recovery day. Transducers should be downloaded and data verified after each test. Transducers will need to be moved to alternate locations during the second and third recovery test, as determined by the FS Lead.

3.17 At the completion of the recovery tests, all equipment should be removed from the wells, cleaned, packaged, and shipped back to the appropriate vendors. Locks shall be placed on all wells and piezometers.

3.18 The 55-gallon drum(s) will be sealed, labeled, and brought back to the IDW staging area in accordance with the Site Management Plan. All PPE and other IDW wastes will be disposed of in accordance with the Site Management Plan.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Refer to the Health and Safety Plan for appropriate health and safety precautions. At a minimum, eye protection, poly-coated Tyvek, and nitrile gloves will be worn during at all LNAPL removal tests. Extra care should be taken when walking on the plastic sheeting laid down around the recovery test wells as this could present a trip or slip and fall hazard.

6.0 References

"A Methodology for Estimating LNAPL Conductivity and Transmissivity from LNAPL Bail down Tests: The Lundy and Zimmerman Approach" by Don Lundy (Environmental Systems and Technologies, a Division of Groundwater and Environmental Services, Inc.)

"A Protocol for Performing Field Tasks and Follow-up Analytical Evaluation for LNAPL Transmissivity Using Well Bail down Procedures" by G. D. Beckett (Aqui-Ver, Inc.) and M.A. Lyverse (ChevronTexaco Energy Research and Technology Company), August 2002.

7.0 Attachments

Field forms required for this activity have been attached to this SOP.

Diamond Head Oil Superfund Site
LNAPL Recovery Pilot Test

Page ________ of ________

Date of Recovery Test: ______________________

Field Staff Members: ______________________

Measurement Location	Time	Depth to Product (Ft)	DTW (ft)	Product Thickness (ft)	Recovery Pump Running (Y/N)?	Time	Depth to Product (Ft)	DTW (ft)	Product Thickness (ft)	Recovery Pump Running (Y/N)?	Time	Depth to Product (Ft)	DTW (ft)	Product Thickness (ft)	Recovery Pump Running (Y/N)?
MW-3															
PZ-1															
PZ-2															
PZ-3															
PZ-4															
PZ-5															
PZ-6															
PZ-7															
PZ-8															
PZ-9															
PZ-10															
PZ-11															
PZ-12															

Time															
Vol. LNAPL Purged (gal)															

Type of Recovery Pump in use: ______________________

Revision No. 1
Date: AUgust 2007

STANDARD OPERATING PROCEDURE
AIR / Bio SPARGE PILOT TESTING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for the operation of the air and bio sparge pilot test conducted at the Diamond Head Superfund Site during the Phase 2 Focused Remedial Investigation. This SOP is site-specific and should not be used at other sites without modification.

A pilot scale air sparge test will be completed to assist in the evaluation of bio-sparging for the bioremediation of residual LNAPL. The process of sparging consists of injecting air into the saturated subsurface to remove petroleum compounds through volatilization and biodegradation. Volatilization occurs as air bubbles move through groundwater and into soil vapor. Biodegradation occurs in soil and groundwater as oxygen concentrations in the subsurface increase and promote the growth of natural bacterial populations that degrade petroleum compounds.

Given the shallow depth to water and the shallow depth to the semi-confining low permeability layer beneath the site (peat), the test will be conducted using a horizontal sparge well. Vertical sparge points in the geologic conditions at the site will likely have a small radius of influence, resulting in a very large and potentially unpractical, number of sparge points for a given target area. Horizontal sparge wells are expected to be as effective and less costly.

2.0 Materials

a. Trailer mounted air compressor without heat exchanger (30 scfm at 20 psi capacity)
b. 1" diameter high-pressure rated hose.
c. Electric generator with power rating of 50 KW or at least 1.5 times the anticipated consumption of the sparge compressor.
d. Low-flow groundwater sampling equipment including peristaltic pump and dedicated tubing
e. Water Quality Meter (YSI-600xl or equivalent) capable of measuring dissolved oxygen, temperature, specific conductivity, pH, and oxidation-reduction potential with appropriate calibration solutions
f. Digital manometer (Dwyer or equivalent) capable of reading to within 0.01 inches of water vacuum/pressure
g. Water level meter equipped with an oil/water probe
h. Photoionization detector (PID) with **11.7 eV** lamp
i. GEM 500 or 2000 Landfill Gas Sampler or equivalent capable of measuring percent oxygen, carbon dioxide, methane, and LEL in vapor

j. PPE: Nitrile gloves and safety glasses
k. Field Book
l. Camera
m. Low flow sampling parameter log sheet and LNAPL Recovery log
n. Sample bottles for TCL-VOC (40 mL vials) and heterotrophic plate counts
o. Shipping containers (coolers) with ice
p. Tape Measure, 100 ft. minimum
q. Health and Safety Plan

3.0 Procedure

3.1 <u>Trench Installation</u>: The horizontal air sparge well will be installed in a trench prior to sparge testing. Refer to the subcontractor scope of work for specifics regarding installation.

3.2 <u>Installation of Temporary Well Points / Piezometers:</u> Well point installation of 1-inch diameter temporary piezometers will be conducted prior to air sparge testing. Well point construction details will be documented in well construction logs.

3.3 <u>Installation of Air Sparge Equipment:</u> Pilot test setup will include delivery and installation of a trailer mounted air compressor and an electric generator.

3.3.1 The compressor and generator will be delivered by subcontractors and set at a location approximately 30 feet from the sparge trench, and within 10 feet of each other.

3.3.2 The generator will be connected to the compressor trailer by a licensed electrician, and to a ground rod installed by the electrician. The electrician will start the generator and temporarily energize or 'bump' the compressor to verify that the motor is spinning in the correct direction, and will change leads if necessary to obtain proper direction. The generator will then be shut off.

3.3.3 The compressor effluent will be plumbed to the sparge trench using 1-inch diameter high-pressure rated hose (200 psi minimum) with pressure-rated fittings. The compressor will also have a bleed air effluent which should remain free to discharge to the atmosphere. A heat exchanger will NOT be included with the compressor prior to the effluent. The heat generated by the compressor will nurture the biological processes.

3.3.4 The compressor will be inspected to verify that flow and pressure measurements are available for bleed and effluent flows.

3.3.5 Once installation is complete, the generator will be turned on and the compressor will be performance-tested to verify that the flow and pressure capacity is within the requirements outlined in the

Scope of Work for the equipment vendor. Discrepancies to the flow and pressure capacity will be communicated to the Task Lead.

3.4 <u>Baseline Groundwater Sampling:</u> Groundwater samples will be collected from the 5 temporary well points before commencement of the air sparge testing. A peristaltic pump, following procedures described in the SOP on *Low Stress (Low Flow) Groundwater Purging and Sampling*, will be used to collect groundwater samples from the 5 temporary well points. Due to the small diameter of the temporary well points and the inability to get a bailer into the temporary casing, the samples will be collected directly from the peristaltic pump discharge.

3.4.1 Groundwater samples will be collected and shipped for analysis for TCL-VOCs through the CLP program. Quick turnaround faxed results (3-5 days) will be requested. Because the data will be used for screening purposes only, no quality control samples other than an equipment blank and trip blank are planned. Additional samples will be collected from each well point and sent to a non-CLP laboratory for heterotrophic plate count.

3.4.2 Sampling information will be recorded in the field logbook. Sample containers will be prepared and labeled in accordance with the SOP on*Sample Labeling, Packaging, and Shipping*. Custody information will be completed in accordance with the SOPs on*CLP Laboratory Chain-of-Custody Form* and *Subcontraced Laboratory Chain-of-Custody Form*.

3.4.3 Baseline field groundwater chemistry data will be collected from the 5 temporary well points during collection of the groundwater samples. Baseline monitoring consists of collecting water level and water quality parameters including: dissolved oxygen, pH, conductivity, temperature, and oxidation-reduction potential (ORP). A water level meter will be used in accordance with the SOP on *Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers*. A YSI-600xl or equivalent water quality meter will be used to monitor dissolved oxygen, pH, conductivity, temperature, and ORP from each well point. The water quality meter will be calibrated daily following procedures detailed in the accompanying user manual.

3.4.4 A baseline round of water quality parameters will be collected from all wells within 60 feet of the sparge trench, including the temporary well points, one day prior to air sparge testing. A down hole water quality meter will not be used due to the narrow diameter of the well points. The following procedure will be used to collected groundwater parameter data:

- The depth to water will be measured at the well or well point. LNAPL depth, if present, will be measured and recorded.

- Dedicated field sampling tubing (not to be used for analytical samples) will be lowered into each well so that the bottom of the tubing is located in the screened interval.
- The tubing will then be connected to a peristaltic pump. Groundwater will be purged from the well at a slow rate (no greater than 500ml per minute).
- Water quality parameters will be monitored from the outflow until the values stabilize.
- All readings will be recorded in the attached Air Sparge Data Log.
- Once the data has been recorded, the tubing will be removed from the well point and a cap or plug will be placed on the well point to prevent short circuiting.

3.4.5 A confirmatory baseline round of groundwater chemistry parameters as described in Section 3.4.4 will be collected the morning prior to the air sparge test. In addition, a complete round of water level measurement will be conducted at this time. These results will be compared to the initial baseline to verify that representative samples have been collected.

3.5 Air Sparge Testing: Air sparge testing will be conducted to generally follow the procedure outlined in the In-Situ Air Sparging Engineering and Design Manual (USACE, 1997) for step-rate testing:

3.5.1 The air sparge test will be initiated by first starting with the bleed flow fully open. The bleed flow will be slightly closed to reach a target injection flow rate of 3 scfm (0.1 scfm per foot of well screen).

3.5.2 The injection pressure should be closely monitored during this time. The pressure required to inject air will be greater than the hydrostatic head above the horizontal well, but should be below 0.6 times the overburden pressure above the horizontal well. Pressures above 0.6 times the overburden pressure may result in pneumatic fracturing of the subsurface. The Task Lead should be consulted prior to increasing pressure beyond this threshold.

3.5.3 Once sparging has started, the system should be allowed to operate for a minimum of 2 hours, at which point a complete round of monitoring should be conducted, including;

- Water levels measured from the top of well casing to the water level surface. If LNAPL is present, the thickness of LNPAL should also be recorded.
- Field parameters (dissolved oxygen, temperature, pH, specific conductivity, and ORP).

- Wellhead pressures should be monitored by affixing well caps ported to allow connection to the digital manometer.
- Vapor concentrations in wells screened partially in the vadose zone should be monitoring for VOCs with a PID and for percent oxygen, carbon dioxide, methane, and LEL with a GEM 500 or 2000 landfill gas sampler.

3.5.4 After this first 'step' is complete, the injection flow rate should be increased to the second step rate of 6 scfm (0.2 scfm per foot). A slight pressure increase is expected, the Task Lead should be consulted if significant pressure (above 0.6 times the overburden) is observed.

3.5.5 After a minimum of 2 hours of run time, another complete round of monitoring should be conducted.

3.5.6 Injection flow rates for the third step will be 12 scfm (0.4 scfm/ft), followed by 2 hours of run time, and another complete round of monitoring.

3.5.7 Step rates will increase to achieve 18, 24, and 30 scfm (1.0 scfm/ft), and monitoring will be conducted after 2 hours of run time at each of these rates.

3.5.8 Detail of air sparge operation (flow rates, run time, changes to rates, etc.) will be recorded in Air Sparge Data Logs.

3.5.9 Changes to this procedure, specifically to step flow rates, may be determined necessary by the Task Lead based on test results.

3.6 Respiration Testing

3.6.1 After the air sparge test is complete, a respiration test will be performed before decommissioning of the system. The purpose of the respiration test is to evaluate the activity of the microorganisms in the vadose zone by monitoring the decline of dissolved oxygen in groundwater and oxygen in soil gas over time.

3.6.2 Due to size limitations of the down-hole equipment required for DO testing, the respiration test will only be performed in piezometer PZ-16.

3.6.3 The respiration test must be started while the blower is running. Start the test during the on-cycle of the blower.

3.6.4 Calibrate the O_2 and LEL meter for soil gas measurements according to the manufacturer's instructions. The well riser pipe of piezometer PZ-16 can be used to monitor oxygen in the soil gas because the well screen straddles the water table and includes screen section in the vadose zone.

3.6.5 Calibrate the down-hole dissolved oxygen meter (Hydrolab MiniSonde 4a or equivalent) according to the manufacturer's instructions.

3.6.6 Take a complete round of groundwater DO, and soil gas O_2, LEL, and pressure measurements from PZ-16 while the blower is operating. Record the date and time of the measurements taken using the appropriate field data sheet. Use a direct connect fitting to the monitoring point with a MultiRAE (or equivalent) meter for the soil gas measurements. Use the digital manometer for the pressure readings.

3.6.7 Immediately following completion of the measurements, turn off the blower (turn the main power switch to the off position). Record the date and time; this is time zero. Make sure the blower is completely off and not on the timer.

3.6.8 Take a complete round of O_2 and LEL measurements (pressure is zero) after approximately 1, 3, 5 and 7 days following the date and time the blower was turned off. Record the date and time of the measurements taken at each monitoring point using the appropriate field data sheet.

3.7 Air Sparge Confirmatory Sampling: Groundwater samples will be collected immediately at the conclusion of the last step of the air sparge test. Samples will be collected from the 5 temporary well points, and will be shipped to the laboratory for analysis of TCL-VOCs and heterotrophic plate counts. Confirmatory samples will be collected in accordance to the procedures described above.

3.8 Test Decommissioning: Once the air sparge and respiration tests are complete, the test equipment will be dismantled and returned to its pre-test condition. Equipment vendors will be notified to arrange for return transportation of the generator and sparge trailer. Vertical risers in the sparge trench will be capped and locked.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Refer to the Health and Safety Plan for appropriate health and safety precautions. Compressed air acts like a spring and can release suddenly, causing damage to equipment and potential for personal injury. Safety glasses should be worn at all times during sparge operation.

6.0 References

USACE, 1997. In-Situ Air Sparging Engineering and Design Manual, EM 1110-1-4005. U.S. Army Corps of Engineers. September 15, 1997.

7.0 Attachments

Field forms required for this activity have been attached to this SOP.

Diamond Head Oil Superfund Site
Air/Bio Data Sheet

Date:
Page: 1 of 4

Temp. Piez. ID	Time (24 hr)	DTW (ft BTOC)	D.O. (mg/l)	D.O. (%)	Conductivity (mS/cm)	pH (std. unit)	O.R.P (mV)	Temp (˚C)

Revision No. 1
Date: July 2007

Diamond Head Oil Superfund Site
Air/Bio Data Sheet

Date:

Date	Time	A/S System Running?	Ambient Temperature (°F)	Barometric Pressure (mm HG)	Weather	Influent Temperature (°F)	Effluent Temperature (°F)	Bleed Flow (SCFM)	Total Flow (SCFM)	Influent Pressure (psi)	Effluent Pressure (psi)	Well Head #1	Pressure (psi)	Flow (SCFM)	Well Head #2	Pressure (psi)	Flow (SCFM)

Comments:

Diamond Head Oil Superfund Site
Air/Bio Data Sheet

Date:

Well ID	A/S Running?	Time	Air Sparge Vapor Parameters					
			C02	CH4	O2	LEL	PID	FID

Well ID	A/S Running?	Time	Air Sparge Vapor Parameters					
			C02	CH4	O2	LEL	PID	FID

Well ID	A/S Running?	Time	Air Sparge Vapor Parameters					
			C02	CH4	O2	LEL	PID	FID

Diamond Head Oil Superfund Site
Respiration Test Data Sheet

Sampled By: ____________________

			Groundwater		Soil Gas		
Well ID	Date	Time (24 hr)	D.O. (mg/l)	D.O. (%)	Pressure (inches H_2O)	O_2 (%)	LEL (%)
PZ-16							
PZ-16							
PZ-16							
PZ-16							
PZ-16							
PZ-16							
PZ-16							
PZ-16							
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STANDARD OPERATING PROCEDURE
VEGETATION CLEARANCE AND ROAD CONSTRUCTION DOCUMENTATION

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for oversight and documentation of the vegetation clearance and temporary road construction conducted within the investigation work areas.

Existing onsite roadways will be improved so that heavy vehicle traffic can utilize them. The road construction will bring up the existing grade of the existing roadways to ensure that they are no longer subjected to flooding or muddy conditions which could prevent equipment transport. The total length (footage) of the road improvements is approximately 200 feet with a nominal width of 12-feet. The existing access ramps to the landfill will also be improved and are estimated to be approximately 50 feet in length with the same width.

New gravel roads will also be constructed to areas of the site that were previously inaccessible due to existing site conditions such as soft swampy ground, uneven terrain, and the presence of earthen drainage ditches. Approximately three short gravel access roads will be constructed with a nominal width of 12-feet. The total discontinuous length (footage) of the new roads is approximately 960 feet. A turnaround will also be constructed and is approximately 40 feet by 40 feet.

All road construction and vegetation clearance activities will be documented in the field log book.

Approximate road locations have been identified on *Figure 1 Proposed Temporary Gravel Road, Landfill Excavations, and Delineated Wetland Location Map,* of the subcontracting scope of work.

2.0 Materials

a. Field Book and Field Log in this SOP
b. Camera
c. Tape Measure, 100 ft. minimum
d. Figure 1 Proposed Temporary Gravel Road, Landfill Excavations, and Delineated Wetland Location Map
e. Health and Safety Plan
f. Subcontractor Statement of Work (SOW) for vegetation clearance and road improvements / construction

3.0 Procedure

3.1 Vegetation Clearance:

3.1.1 Area East and North of Landfill: Prior to the initiation of roadway construction, vegetation generally consisting of 15-foot tall phragmites, tall grass, underbrush and some poison ivy will be cleared in the area to the East and North of the landfill. This clearance will cover the layouts of the roadway improvements and new roadways. Small shrubs and sapling trees will also be cleared but trees greater than 2-inches in diameter will not be cut down. In order to minimize ground clutter and tick habitat, the cut vegetation will be staged in an area designated by CH2M HILL at the Site so it does not impede access routes or work areas.

The field team lead and/or RI task lead will mark out a predetermined stockpile location prior to this activity.

When cutting and removing vegetation; underlying soil is not to be disturbed (e.g.; no bulldozing of the entire surface).

3.1.1 Landfill: The areas to be cleared of vegetation include two linear paths over the landfill, each approximately 800 feet long (1600 linear feet total), with widths of 30 feet or as wide as needed to allow for up to 10 feet deep exploratory trenching.

3.1.1 Soil berm along the east border of the property – Vegetation will also be cleared on the berm to allow access for the LIF investigation. The cut vegetation will be staged in an area designated by CH2M HILL at the Site so it does not impede access routes or work areas.

3.1.1 CH2M HILL will document the location and dimensions of vegetation clearance, a description of the clearance activities in the field log book and will provide before and after photographs documenting the clearance activities.

To the East and North of the landfill, the photographs will be taken along a 360 degree circle (4-8 photographs) from a selected standing location.

On the landfill, the photographs will be taken along the cleared paths.

3.2 Improving Existing Dirt Roadways:

3.2.1 Review Subcontractor SOW for Road Construction and review Subcontractor work for compliance with the requirements in the SOW.

3.2.2 Assign a name to each roadway and a sequential number to the points along the roadway where documentation will be collected.

Documentation will be approximately every 50 feet along the length of the road and include: 1) Photographs taken along a pre-selected side of the road (e.g., facing always east along a roadway) and 2) Measurements of the width of the roadway and the depth of the stone layer in feet and inches, respectively. Record the information in the table format provided with this SOP.

The coordinates of the documentation points will be taken using the GPS unit.

Use a label for each photograph to be able to position where the photograph was taken (e.g., a page with handwritten 2 indicates the second documentation point along the roadway).

The information collected will be used to assemble a photo log keyed to a numbering system which in turn is keyed to a table documenting the dimensions. The numbering system will be shown on the "as-built" for the roadways and can be used to reference photographs and the dimensions at each location. Document conditions and grading of low lying areas and depressions before lying of geotextile fabric.

3.2.3 Document the road dimensions as Subcontractor grades and prepares to lay down the geotextile (estimated: 12' Width & 200' discontinuous total length). Record measurements and obtain photographs at pre-selected points.

3.2.4 Document installation of geotextile fabric. Record fabric specifications, manufacturer, and lot number (if applicable). Obtain photographs at pre-selected points.

3.2.5 Document the delivery of stone to the site. Obtain bills of laiding, weight tickets, etc. from each delivery truck to track the total volume of material delivered. Each ticket should include a description of the material delivered and certification of clean stone (may be provided once per quarry/source of material).

3.2.6 Document the thickness of the layer of stone - layer of minimum 2-inch diameter stone with a thickness of 3- to 6-inches must be placed on top of the geotextile fabric. **Crushed concrete will not be acceptable for use and will be rejected.**

3.2.7 Document the actual road dimensions following installation of the stone layer (estimated: 6" thickness and 12' Width) over the estimated 200' discontinuous total length plus the access ramps. Obtain photographs at pre-selected points.

After completing construction, GPS the centerline of the roads (survey points at 10 foot intervals).

NOTE: Actual thickness of the road will vary depending on ground conditions, soil characteristics, and susceptibility to flooding. Record thickness in inches at the pre-selected points as close as feasible.

3.2.8 Document in the field log book a description of the construction activities performed including the daily duration of activities, the actual length of roadways constructed, quantities of materials used, equipment used, dust control measures used, decontamination procedures used, issues noted and certification of clean stone.

3.3 *Construction of new gravel roadways, turnaround area, and landfill access ramps:*

3.3.1 Review Subcontractor SOW for Road Construction and review Subcontractor work for compliance with the requirements in the SOW.

3.3.2 Assign a name to each roadway and a sequential number to the points along the roadway where documentation will be collected.

Documentation will be approximately every 50 feet along the length of the road and include: 1) Photographs taken along a pre-selected side of the road (e.g., facing always east along a roadway) and 2) Measurements of the width of the roadway and the depth of the stone layer in feet and inches, respectively. Record the information in the table format provided with this SOP.

The coordinates of the documentation points will be taken using the GPS unit.

Use a label for each photograph to be able to position where the photograph was taken (e.g., a page with handwritten 2 indicates the second documentation point along the roadway).

The information collected will be used to assemble a photo log keyed to a numbering system which in turn is keyed to a table documenting the dimensions. The numbering system will be shown on the "as-built" for the roadways and can be used to reference photographs and the dimensions at each location. Document conditions and grading of low lying areas and depressions before lying of geotextile fabric.

3.3.3 Document the road dimensions as Subcontractor grades and prepares to lay down the geotextile (estimated: 12' Width & 960' discontinuous total length and 50 by 40 turnaround). Record measurements and obtain photographs at pre-selected points.

3.3.4 Document installation of geotextile fabric. Record fabric specifications, manufacturer, and lot number (if applicable). Obtain photographs at pre-selected points.

3.3.5 Document the delivery of stone to the site. Obtain bills of laiding, weight tickets, etc. from each delivery truck to track the total volume of material delivered. Each ticket should include a description of the material delivered and certification of clean stone (may be provided once per quarry/source of material).

3.3.6 Document the thickness of the layer of stone - layer of 4-12 inch diameter stone with a thickness of 12-24 inches will be layered on top of the geotextile fabric, followed by a layer of 3 inch dense aggregate of maximum 2 inch diameter or equivalent to fill void spaces. **Crushed concrete will not be acceptable for use and will be rejected.**

3.3.7 Document the actual road dimensions following installation of the stone layer (estimated: 15-27" thickness and 12' Width) over the estimated 960' discontinuous total length of roadway and the turnaround. Obtain photographs at pre-selected points.

After completing construction, GPS the centerline of the roads (survey points at 10 foot intervals).

NOTE: Actual thickness of the road will vary depending on ground conditions, soil characteristics, and susceptibility to flooding. Record thickness in inches at the pre-selected points as close as feasible.

3.3.8 Document in the field log book a description of the construction activities performed including the daily duration of activities, the actual length of roadways constructed, quantities of materials used, equipment used, dust control measures used, decontamination procedures used, issues noted and certification of clean stone.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Review the Health and Safety plan and relevant (i.e. earthmoving, excavating…) SOPs associated with the roadways construction field task. Project team member(s) overseeing the roadway construction must have 10-hr OSHA Construction training.

6.0 References

None.

7.0 Attachments

Field forms required for this activity have been attached to this SOP.

Diamond Head Oil Superfund Site
Road Construction Record

Road designation	Documentation point (sequential number)	GPS Coordinates	Photograph after grading	Width (ft)	Photograph after geotextile placement	Photograph after stone placement	Thickness of stone inches	Width ft	Comments

STANDARD OPERATING PROCEDURE
LANDFILL TRENCHING AND DOCUMENTATION OF LANDFILL MATERIALS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for oversight of the trenching to be conducted within the landfill and associated documentation of landfill materials. Approximate landfill trenching locations have been identified in the Sampling and Analysis Plan – Attachment A: Site Management Plan.

Two test trenches will be excavated to visually observe the contents of the landfill. The total estimated length of the trenches is 1,600 linear feet (two 800-ft trenches). The trenches will be attempted to a depth of 10 feet or will terminate at the water table if it is encountered shallower than 10-feet.

All erosion control, vegetation clearance, landfill trenching and subcontractor oversight activities will be documented in the field log book.

2.0 Materials

a. Field Log Book
b. Camera
c. Tape Measure
d. PID
e. Photo Log and Test Pit Log Sheets
f. Health and Safety Plan
g. Figure – Aerial Photograph Showing Approximate Layout of Roadways and Landfill Trench Layout
h. Subcontractor Statement of Work (SOW) for vegetation clearance and road improvements / construction and Compensation Schedule

3.0 Procedure

3.1 Vegetation Clearance

Vegetation clearance in support of the landfill investigation is described in the Vegetation Clearance and Road Construction SOP.

3.2 Erosion Control

- Subcontractor is required to implement erosion control measures (e.g., constructing a hay bail or silt fencing) around the perimeter of each excavated trench segment.

- Take photographs of the erosion control prior to beginning excavation.

3.3 Landfill Trenching:

3.3.1 Scope of Oversight

Field personnel will provide oversight and maintain documentation for the following:

- Health and safety monitoring
- Subcontractor oversight for compliance with subcontract requirements including contingency if drums are encountered and recording quantities in the field for payment
- Documentation of observations of encountered conditions

Specific instructions and documentation requirements under each are described below.

3.3.2 Health & Safety Monitoring

- Air quality parameters will be monitored during intrusive activities (per the Health and Safety Plan) for volatile organic vapors (PID), explosive vapors (LEL), methane (CH_4), hydrogen sulfide (H_2S), and dust. Proactive dust control measures will be taken by the subcontractor such that no visible dust clouds form in the work area.

- Entering the excavation is prohibited.

- Document the results of air monitoring (including "zero" readings) on the excavation log field form at least every 20-feet of excavation.

- Ensure that an exclusion zone is established around the active excavation area. The outer perimeter of the erosion control barrier may be a good boundary.

3.3.2 Subcontractor Work Oversight

- Review Subcontractor SOW for landfill trenching and review Subcontractor work for compliance with the requirements in the SOW.

- Due to the unknown nature of the landfill contents, the trenching program will be a dynamic process that adapts to encountered field conditions. Trenching will begin at the outer edge of the landfill on the north end by one of the gravel construction entrance roadways. The excavation will begin outside the edge of the landfill so that observations can be made to establish the depth of the landfill debris compared to the native soil and the depth of groundwater.

- The trenches within the footprint of the landfill will be of varying depth due to the irregular shape of the landfill, targeting the full thickness of the landfill materials or to the groundwater table, whichever is encountered first. The depth to the water table in the landfill is estimated at approximately 10 feet below the top of the landfill. Therefore, the test trenches will be attempted to a depth of 10 feet or will terminate at the water table if it is encountered shallower than 10-

feet. Slope stability and field conditions will also be used in determining the final trench depth.

- Excavation will be performed in a manner that will not require benching, sloping (1:1) or shoring of the excavation walls because of the nature of the materials into which the excavation will proceed (i.e., debris of irregular size and shape).
- The excavation will be installed in segments of 10-15 feet in length to manage slope stability and prevent collapse. The width of the trenches at the base will be approximately 3 feet (the bucket-width of an excavator) but may be expanded based on encountered conditions for the stability and safety of the excavation
- The subcontractor will provide a "competent person" to oversee installation of the trench. **CH2M HILL will NOT provide direction to the subcontractor pertaining to means or methods of trench installation.**
- Excavated spoils (i.e., materials) will be temporarily staged close to the excavation but maintaining a minimum distance to prevent collapse and meet OSHA regulations.
- Following observation and logging, the spoils will be backfilled into the excavation and compacted with the excavator bucket. **Each segment of the trench will be excavated and backfilled in the same day so that no excavations are left open overnight.**
- If large debris is encountered in the intended path of the excavation that is impassable with reasonable effort, the excavation will be abandoned at that location and resumed as close as possible to this location further along the intended path of the excavation.

3.3.2.1 Drum Contingency

- If drums or suspect material are encountered, the excavation will be stopped and the field team leader will immediately contact the Remedial Investigation Lead and/or Project Manager who will in turn contact the EPA and the USACE for direction.
- The subcontractor will maintain an emergency response trailer and supplies at the site throughout the duration of the landfill investigation. In the event that unclassified contamination is encountered (e.g. buried drums), sufficient PPE, respiratory protection, and materials (e.g. sorbent materials, overpack salvage drums, etc.) will be available to mitigate a localized spill or release of contaminants. In addition, prior to commencing the landfill investigation, the USEPA will attempt to schedule

their Emergency Response Team (ERT) for stand-by response to the site to manage unclassified wastes.

- In general, any drums or suspect material observed within the excavation will be left in place. If materials are discovered in the spoils exhumed from the excavation, or if a buried drum is ruptured and observed to be leaking, responsive measures will be taken by the appropriately trained subcontractor staff to mitigate the situation. Response measures will only be implemented after appropriate upgrades to PPE are implemented. Worker health and safety are of primary concern and are immediately followed by protection of the environment.
- Ruptured drums or spills must be secure by the subcontractor in overpack salvage drums. The surrounding soil will be removed and stockpiled on plastic and covered near the excavation. Photos of the ruptured drum, trench and soil stockpile location should be taken by CH2M HILL.
- While remediation of buried drums is not the intent of this investigation, the subcontractor will be equipped to handle incidental spills. Sampling and analysis for waste characterization and drum disposal will be performed by CH2M HILL at a later date. Any overpacked drums will be temporarily staged on plastic sheeting at the site until a direction for path forward is determined.
- If practicable while waiting for direction from USEPA and USACE and in order to minimize the amount of subcontractor downtime charges, the excavation equipment will be moved along the intended path of the excavation (e.g., 20 feet away) and digging will resume.

3.3.2.2 Subcontractor Payment Terms

- "Daily quantities" of materials and services will be tracked by CH2M HILL to facilitate review of subcontractor invoices for approval and payment. CH2M HILL's tracking will be independent of that performed by the subcontractor but the Field Team Lead and subcontractor's foreman are encouraged to discuss and come to consensus on daily work activities. A copy of the subcontract "Compensation Sheet" detailing line item work activities and units of measure will be the basis for tracking the daily quantities.

3.3.3 <u>Landfill Investigation Documentation</u>

- Detailed and thorough documentation of observations throughout the excavation are critical success factors for the landfill evaluation. Documentation of "negative" results are as important as "positive" findings. Standard test pitting procedures and documentation will be implemented and will include at a minimum the following details:
- Document the presence, description, and location of any large debris that is encountered in the intended path of the excavation that is impassable with reasonable effort and that requires excavation efforts to move along the path of the excavation. Each location where this occurs shall be documented with a photograph and the coordinates recorded with the GPS unit.
- Using test pit excavation logs, record / document the observations made in each segment of the trench. Include descriptions of each trench wall, the trench floor, and the spoils removed from the trench.
    - Provide a detailed description of the spoils matrix (e.g., primary soil component) including soil USCS description, soil composition, color, odor, and debris description (concrete, metal, brick, glass, timbers, plastic, etc.) including size of the debris
    - Record any observed staining, odor, or PID readings. Document stained areas in photographs.
    - Record if and at what depth groundwater is encountered.
    - Record the presence, description, and location of any large debris that is encountered. Document large debris in photographs.
- Using a key tied to photographs and the attached record, collect the following information:
    - Assign a unique, sequential identification designation to each excavated segment of each trench. For example, LTR-W-01 is the 1st excavated segment in the west trench.
    - Record the dimensions of each segment to the nearest half-foot including length, width and depth. GPS and record the boundaries (at least 4 end points) of each segment.,
    - Collect photographs of the following for each segment: general wide-angle; all four sides of the excavation, the bottom of the excavation, the pile of exhumed spoils, and any points of interest (see above – stained soils, large debris, other). The photos will be correlated to the test pit logs prepared for each segment. Care must be taken to obtain a useable photographic

log that provides ample detail of the subject matter including trench segment ID, scales, and/or reference features.

Use a label for each photograph to be able to position where the photograph was taken (e.g., a page with handwritten LTR-E-22 indicates the second segment along east trench).

- After completing all trenching, GPS the centerline of the trench (10 foor intervals).
- In the field log book, record the daily progress of the excavation and backfilling activities. Include a written description of the excavation activities performed including the duration of activities, equipment used, soil erosion measures implemented, dust control measures used, decontamination procedures used, restoration performed and issues encountered.

3.4 Landfill Investigation Soil Sampling

- Five soil samples will be collected from each excavation trench. The sample locations will be evenly spaced along the length of the trench unless staining or other environmental considerations are observed that warrant biasing the sample collection location. The samples will be collected from a fresh segment of soil directly from the excavator bucket after brushing away the top layer of soil in the bucket.
- Samples will be collected for full TCL organics and TAL inorganics analysis. Full Q/C sampling will be collected including duplicate, MS/MSD, equipment blank, and trip blank samples. Refer to the sampling SOPs on sampling method, sample nomenclature, bottling, and shipping requirements.
- Document all sampling time and sample location and depth in the log book as well as on the test pit log for the segment from which the sample is collected.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Review the Health and Safety plan and relevant (i.e. earthmoving, excavating…) SOPs associated with the Landfill Trenching field task. Project team member(s) overseeing the Landfill Trenching must have 10-hr OSHA Construction training.

6.0 References

Figure - Aerial Photograph Showing Approximate Layout of Roadways and Landfill Trenches

Subcontract SOW and Compensation Schedule

7.0 Attachments

Field forms required for this activity have been attached to this SOP.

Diamond Head Oil Superfund Site
Landfill Trenching Record

Trench *(east/west)*	Segment (sequential number) *(LTR-W-01)*	GPS Coordinates (segment boundaries)	Length (ft)	Width (ft)	Depth (ft)	Staining (Y / N)	Sample collected (Y / N)	Min required photos taken (2 sides, bottom, spoils, wide-angle)	Comments

CH2MHILL

PROJECT NUMBER	TEST PIT NUMBER SHEET OF

TEST PIT LOG

PROJECT: Diamond Head Oil Superfund Site LOCATION : Harrison Ave, Kearny, NJ 07032 (Hudson LOGGER :
ELEVATION : CONTRACTOR :
EXCAVATION EQUIPMENT USED : DATE EXCAVATED:
WATER LEVEL : APPROX. DIMENS: Length: Width: Max. Depth:

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS	
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, WATER SEEPAGE, GRADATIONAL CONTACTS, TESTS, INSTRUMENTS. PID (ppm):	Notes
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

Revision No. 1
Date: August 2007

STANDARD OPERATING PROCEDURE
GLOBAL POSITIONING SYSTEM (GPS) SURVEY METHODS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to establish protocols for the use of a global positioning system (GPS) for obtaining survey quality position data (e.g., latitude and longitude). Each sample location or significant point of measurement will have a GPS reading taken to uniquely identify and document the locations of investigative features. Surveyed features will include: the center line of the temporary roadways, the centerline of the air / bio sparge trench, landfill test trenches, LIF boring locations, and temporary piezometers. This SOP is based on the manufacturer's instruction manual. Data generated from the use of this SOP will be used to support the Phase 2 remedial investigation and feasibility study.

2.0 Materials

a. GPS Pathfinder® Pro XRS receiver GPS unit and accessories
b. Receiver battery and battery charger
c. TerraSync™ and Pathfinder Office™ software

3.0 Procedure

The following steps summarize how to use the Global Positioning System Unit. For detailed instructions refer to the manufacturer's user's guide:

3.1 Before beginning the survey, the following preparation procedures shall be followed:

1) Check the Quick Plan utility, included with the Pathfinder Office software, for satellite visibility for the area of data collection utilizing a current almanac. This utility can predict position dilution of precision (PDOP) during each day and identify the optimal times for collecting data. The GPS user will confirm that the almanac file is less than 30 days old. A PDOP of 4 or less yields optimal precision, a PDOP between 5 and 7 is acceptable; a PDOP of 7 or more is poor.

2) Check Notice Advisories for Navstar Users for any planned outages. Updated GPS Constellation status reports can be found on the internet at the following location: http://www.navcen.uscg.gov/navinfo/Gps/ActiveNanu.aspx

3) Plan data collection effort in accordance with satellite availability and optimum PDOP.

4) Check for and load any waypoint files that will be necessary for the project.

5) Print out a copy of the data dictionary for use in the field (optional). The data dictionary, included with the Pathfinder Office software, creates custom pick-lists, automatic repeat feature, and numeric values so that collecting many features and attributes is easy and accurate. In the field, the data dictionary prompts the field crew to enter specific information-ensuring data integrity and compatibility with the GIS or database.

6) Check condition of receiver batteries.

7) Assemble equipment and check critical configuration. (PDOP, signal to noise ratio (SNR), el angle, mode, logging rate)

8) Take equipment outside and turn on to ensure that equipment initializes, log a short rover file. Check to see that data dictionary for the project is loaded on the datalogger.

9) Review battery status for datalogger (internal and backup).

10) Download file and check in PathFinder Office. Review file to ensure accuracy

11) Disassemble and pack equipment for travel. Disconnect external batteries.

3.2 After completing the above preparation procedure, the following steps shall be performed at the site:

1) Assemble equipment, turn on equipment for initialization.

2) Go to Data Capture on Main Menu - Select.

3) Go to Create Rover File - Select.

4) Name file in accordance with project guidance or accept default name.

5) Set antenna height and type.

6) Move to feature to be logged and select feature.

7) Record positions for feature in accordance with plan and available PDOP. A minimum of 5 satellite data points will be collected at each survey location. Complete attribute information for the feature as appropriate.

8) Close feature after requisite number of readings.

9) Move to next feature and select feature, etc. After last feature, exit data capture by pressing the clear button and confirming exit with the appropriate soft key.

10) Turn off equipment, disassemble and pack for transport. Disconnect receiver batteries.

4.0 Maintenance

Maintenance of the GPS equipment will be performed by the equipment rental vendor.

5.0 Precautions

Equipment will not be used in adverse weather conditions. Only project team members familiar with the Trimble GPS system will be allowed to operate and collect data points.

6.0 References

The GPS rental equipment vendor will be responsible for supplying the project team with an up-to-date user manual.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE TRANSIT LEVEL AND STADIA ROD FOR ELEVATION MEASUREMENTS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to establish protocols for use of the Level Transit and Stadia Rod for elevation measurements. CH2M HILL will utilize transit level and stadia rod techniques to measure elevations of investigative features. Surveyed features will include all temporary piezometers. Data generated from the use of this SOP will be used to support the Phase 2 remedial investigation and feasibility study.

2.0 Materials

a. Stadia Rod
b. Transit Level with Tripod
c. 100' Measuring Tape
d. Field log book

3.0 Procedure

The following steps summarize how to use the transit level and stadia rod. For detailed instructions refer to the manufacturer's user's guide:

1. Elevation measurements with the transit level are obtained by extrapolating the height of a feature of interest compared to the height of a point of know elevation generally referred to as a "benchmark". For the Phase 2 investigation at the Diamond Head site, benchmarks set by a licensed surveyor during the Phase 1 investigation activities will be used as a reference point. In addition, the known elevation of identifiable features such as the rim of permanent monitoring wells may be used as benchmarks.

2. Identify the benchmark to be used that is in unobstructed view of the investigation feature of interest and determine the elevation of the benchmark above mean sea level based on Phase 1 Investigation documentation. Record this elevation (BM_{elev})

3. Assemble the transit level and tripod unit. Position the tripod over the benchmark so that the center of the transit level unit base is directly over the known reference point on the benchmark. Use the plumb bob to center the point. Referencing the bubble levels on the transit and the adjustable screw legs/wedges on the transit unit, orient the transit unit to a level plane on the horizon (i.e. level the unit). Note that extending the tripod legs to different lengths may be necessary to compensate for uneven terrain.

4. Measure to 0.01-foot precision the height above the benchmark of the center of the telescopic lense on the transit level (or other reference point indicated by the manufacturer on the transit level unit) and record this value (H_T).
5. Next, a field team member holds the stadia rod in a vertical position on the feature to be measured. Ensure that the stadia rod is extended to sufficient height to be seen by the transit operator and that the stadia rod is held level vertically (plumb) by referencing the bubble level on the stadia rod.
6. Using the telescopic sight on the transit level, the transit operator reads to the nearest 0.01-foot precision the height of the telescopic sight cross-hairs on the calibrated stadia rod. Record this sighting measurement (S_R).
7. Calculate the elevation of the point of interest (PT_{elev}):

$$\mathbf{BM_{elev} + H_T - S_R = PT_{elev}}$$

Note:
The value S_R will be subtracted in the equation if the point of interest is located up-slope (i.e., above) relative to the benchmark.

The value S_R will be added in the equation if the point of interest is located down-slope (i.e., below) relative to the benchmark.

4.0 Maintenance

Handle the level transit and stadia rod carefully. Keep them clean and dry.

5.0 Precautions

Do NOT get the survey equipment wet. Do NOT survey in the rain. Avoid overhead utility lines and lightning storms.

6.0 References

Compton, R. R. (1985) *Geology in the Field.* New York: John Wiley and Sons. Pp. 135-147.

7.0 Attachments

None

STANDARD OPERATING PROCEDURE
SAMPLING OF SOIL DURING LANDFILL TRENCHING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the protocol for sampling soils encountered during the landfill investigation. The soil samples will be collected directly from the excavator bucket. This SOP describes the procedures to use for collecting soil samples for both organics (including VOCs) as well as metals analysis. This SOP follows the steps in the "Draft Procedures for Collecting Samples When Using EnCore™ Samplers for Analysis through the USEPA Contract Laboratory Program (CLP)".

2.0 Materials

1. Excavator and associated earth moving equipment.
2. A stainless steel trowel
3. Stainless-steel tray or bowls
4. Photoionization (PID) detector
5. En Core™ Samplers (5g)
6. T-handle
7. Sample bottles
8. Paper towel
9. Sample Collection Log Sheet
10. Shipping containers (coolers)

3.0 Procedure

3.1 The landfill investigation will involve the creation of two trenches throughout the length of the landfill. Excavated spoils will be observed and logged and soil samples will be collected directly from the bucket after a "fresh" area of soil is exposed by brushing off the surficial soils away from the top of the bucket.

3.2 Five samples will be collected from each of the two trenches (total of 10 samples and associated quality control samples) in a predetermined spacing which will be determined as part of staking the layout of the trenches. Soil samples will be collected from varying trench depths due to fluctuations in the water table and encountered debris.

3.3 Soils will be screened with a PID and observed for staining. Soil with the greatest indication (e.g., PID readings, visual staining) of potential contamination will be sampled for laboratory analysis. In the absence of field screening indications of contamination, soil samples will be collected from middle of the trench.

3.4 At each sampling point, **the soil sample for VOC analysis will be collected first.** Within each bucket, the section from which the sample will be collected, will be selected based on the following criteria, listed in order of importance:

- results of PID measurements (soils with high PID readings will be sampled)

- visible staining or discoloration
- middle section of the trench or professional judgment if the PID or observations do not indicate the presence of any VOCs

3.5 Samples for VOC analysis will be collected using En Core Samplers. Note that duplicate samples for VOC analysis are to be collected from the same interval as close as possible to each other. These duplicate samples are also known as co-located samples. Once the sample for VOC analysis is collected, the remaining soil from the pre-determined sample interval will be placed in a stainless steel mixing bowl and the samples for the remaining analyses collected.

3.5 Samples for VOC analyses will be collected as follows:

- Collect three En Core™ samples and one 120ml wide mouth glass jar to determine moisture content for each sample point location.
- Remove the sampler and cap from the En Core™ package and attach the T-handle to the sampler body.
- Quickly push the sampler into a freshly exposed surface of soil (ground surface or soil core sampler) until the sampler is full.
- Check to see whether the sampler is full by looking into the viewing hole in the T-handle. The back o-ring on the plunger will show in the viewing window when soil has fully pushed the plunger back. The plunger can only be rotated when it is completely pushed to the back of the sampler body. If the plunger can be twisted, this indicates that soil has completely filled the sampler and the back o-rings have sealed.
- Scrape any excess soil flush with the edge of the sampler using a dedicated or decontaminated stainless steel trowel.
- Use a paper towel to quickly and carefully wipe the sampler head so that the cap can be tightly attached and sealed.
- To attach the cap, push the cap on with a twisting motion. The cap is properly sealed when the two locking arms are completely seated over the ridge on the body of the sampler.
- Complete the sample label on the En Core™ zipper lock package.
- Fill in the sample identification number (i.e. CLP number) on the self adhesive label attached beneath the sample label on the En Core™ package.
- Tear the self adhesive label at the perforation and attach the label to the rim of the sampler cap.
- Place the sampler back into the En Core™ zipper lock package and seal the zipper lock. The CLP Sample label may be used as a custody seal to be

placed over the opening of the En Core™ zipper lock package to ensure sample integrity. If the CLP label is not used as a custody seal, the CLP sample label must be attached to the exterior of the En Core™ package and a custody seal place over the opening of the package.

- Repeat the procedure above for the other two samplers. Once all three samplers have been filled, labeled and packaged, place the three En Core™ packages into one large zipper lock bag with one completed sample tag. Sample tags are required by the CLP, unless waived by the Regional Sample Control Coordinator (RSCC).
- Collect the percent moisture sample in a separate sample container (60ml wide mouth glass container). Use a paper towel to clean the threads of the sample container and cap. Ensure that the sample bottle is tightly sealed to prevent loss of soil moisture.
- Double volume is required for the collection of the MS/MSD samples. This includes six En Core™ samplers and two 60ml wide mouth glass container.
- Store all samples in a cooler with bagged ice to maintain 4 degrees Celsius while storing on site and during shipment to the laboratory.
- Samples must be shipped off site to the laboratory within 24 hours.

3.6 For the remaining TCL organic analyses and the TAL analyses, samples, collect soil from the excavator bucket using a decontaminated stainless-steel trowel and place it into a decontaminated stainless steel pan and mix as follows:

- Roll the contents of the compositing container to the middle of the container and mix.
- Quarter the sample and move to the sides of the container.
- Mix each quarter individually, then combine and mix OPPOSITE quarters, then roll to the middle of the container.
- Mix the sample once more, then quarter the sample again.
- Mix each quarter individually, then combine and mix ADJACENT corners, then roll to the middle of the container. The goal is to achieve a consistent physical appearance before sample containers are filled.
- Flatten piled material into an oblong shape.
- Using a flat-bottomed scoop, collect a strip of soil across the entire width of the short axis and place it into a sample container.
- Repeat above step at evenly-spaced intervals until the sample containers are filled.
- Record the approximate quantity of each subsample in the field log book.
- Place the required soil volumes in specified sample containers for the remaining laboratory analyses, tightly cap, and fill in all required information on the bottle label.
- Immediately following sample collection, place the sample bottles in a cooler with ice. Maintain the samples at $4^0 \pm 2^0$ C.

- Samples must be shipped off site to the laboratory within 24 hours.

4.0 Maintenance

Not Applicable.

5.0 Precautions

5.1 Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

USEPA. Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies, EPA Publication EPA/600/R-92/128, July 1992.
USEPA. Soil Screening Guidance: User's Guide(Superfund), EPA OSWER Pub. 9355.4-23, July 1996.

7.0 Attachments

Field forms required for this activity have been attached to this SOP.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sample Type	Composite Yes or No	Sampling Method	Depth of Sample Top	Depth of Sample Bottom	Units	Sample Date	Sample Time	COC Date	Analyses	Case Number	Date received [illegible]	[illegible]
LIF - Soil Intact Core Sample																	
Example																	
LIF-87	LIF-87-10-13-2			SO	N	Y	Intact Core - Geoprobe	10	13	ft	1/27/2008	16:00	1/27/2008	Pore Fluid Saturation/ Core photography			
LIF - Soil SPLP Leachability																	
Example																	
SB-39	SB-39-07-09			SO	N	N	D.P.T	7	9	ft	2/28/2008	07:47	2/29/2007	SPLP for VOCs and SVOCs			
Soil (Landfill Investigation):																	
Example																	
LTR-E-01	LTR-E-01-2	BOFA7/MBODZ2	BOFA7	SO	N	N	Hand	9	10	ft	12/26/2007	13:29	12/26/2007	TCL-full, TAL-Metals	30708		
Groundwater (Air/Bio Sparge Evaluation) Sample:																	
Example																	
TPZ-07	TPZ-07-1-2	BOFA8		GW	N	N	Low Flow				12/16/2007	10:07	12/16/2007	TCL-VOCs	30942		
TPZ-10	TPZ-10-2-2			GW	N	N	Low Flow				12/16/2007	10:07	12/16/2007	Bacteria Count			
LNAPL (Fluid Properties) Pair Sample:																	
Example																	
MW-03	FP-MW-03-2			FP	N	N	Bailer				1/2/2007	14:07	1/2/2007	LNAPL Fluid Properties			
MW-03	GW-MW-03-2			GW	N	N	Bailer				1/2/2007	14:17	1/2/2007	LNAPL Fluid Properties			
IDW (Decontamination Water):																	
Example																	
WW	WW-01-02	BOEB9/MFOOV3		WW	N	N	Bailer				3/14/2008	13:50	3/14/2008	TCL-Full, TAL-Metals	30125		
WW	WW-01-02			WW	N	N	Bailer				3/14/2008	13:50	3/14/2008	Haz Waste Characteristics (ignitability, corrosivity, reactivity)			
IDW (LNAPL):																	
Example																	
FP-IDW	FP-IDW-01-02			FP	N	N	Bailer				3/15/2008	16:20	3/15/2008	TCLP and Haz Waste Characteristics (ignitability, corrosivity, reactivity)			
Fire Hydrant Water Samples:																	
Example																	
FH	FH-01-02	B0F18/ MB0D49		W	N	N	Hand				12/15/2007	08:12	12/17/2007	TCL-Full, TAL-Metals	30987		
Equipment and Trip Blanks																	
Example																	
	F-1-11-03-07	B0EN9/ MB0DS9		GW	EB	N					11/3/2007	09:55	11/5/2007	TCL-Full, TAL-Metals	29935		
	T-1-11-03-07	B0ER0		GW	TB	N					11/3/2007	09:50	11/5/2007	TCL VOC	29935		

Legend:

SO	Soil sample	SD	Sediment	N	Normal media sample	TCL-fill	Target compound list - volatile organic compounds, semi-volatile organic compounds, PCBs, pesticides	LNAPL	Light Non-Aqueous Phase Liquid
MS/MSD	Matrix spike and duplicate	FP	Free product	FD	Field duplicate	TCL SVOC	Target compound list - semi volatile organic compounds	TCLP	Toxicity Characteristic Leaching Procedure
SL	Sludge sample	FH	Fire hydrant	EB	Equipment blank	TAL Total Metals	Target analyte list for total metals		
GW	Groundwater sample	WW	Waste water	TB	Trip blank	VOC	Volatile Organic Compound		
SW	Surface water	IDW	Investigation Derived Waste	MSD	Matrix Spike/ Matrix Spike Duplicate	SVOC	Semi-Volatile Organic Compound		

Notes:
CLP numbers never use the letters: O, U, V, I
CLP does use numbers 1, 0

STANDARD OPERATING PROCEDURE
LNAPL SAMPLING DURING LNAPL RECOVERY AND LIF CHARACTERIZATION

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the procedure for collecting LNAPL samples from onsite monitoring wells for LNAPL and LIF characterization. One LNAPL sample will be collected from MW-03S for TCL-full list and TAL analysis. Two LNAPL/Groundwater sample pairs will be collected from two monitoring wells; one sample pair will be collected from MW-03S and one pair will be collected from a monitoring well or piezometer located near a LIF boring with high levels of LNAPL saturation. Both sample pairs will be sent for laboratory fluid properties analysis.

2.0 Materials

1. ¾" Teflon Lined Disposable Bailer
2. 100' of string
3. 8 mil Plastic Sheeting
4. PPE: Nitrile Gloves, Eye Protection, and Poly Coated Tyvek
5. Sample bottles
6. Sample Collection Log Sheet
7. Shipping containers (coolers)

3.0 Procedures

3.1 LNAPL samples will be collected from two predetermined well locations around the LNAPL plume. To confirm the presence of LNAPL, the depth to water and LNAPL thickness will be measured at each sampling location (SOP - *Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometer*) and recorded in the field log book

3.2 Once the presence and thickness of product in a well has been verified, prepare for sampling by placing protective plastic material around the monitoring well.

3.3 Remove the plastic wrapping from the bailer and attach a bailer cord (braided nylon) to the bailer.

3.4 Lower the bailer slowly and gently into well. Since the water table is shallow, watch the top of the bailer and stop lowering the bailer once the top of the bailer is at the water level interface (rest of bailer will be submerged).

3.5 Carefully (avoiding contact with the well walls) withdraw a sample from the well, transfer the sample from the bailer directly into the sample container.

3.6 For the two LNAPL/Groundwater samples collected, a groundwater sample must also be collected for LNAPL fluid properties analysis.

3.6.1 To collect the groundwater portion of the sample pair, the dedicated bailer used to sample the LNAPL will be reused. Slowly lower the bailer into the well and continue to lower (do not drop or splash bailer) the bailer to a depth of approximately five feet below the water table (depth calculated in step 3.1).

3.6.2 Carefully (avoiding contact with the well walls) withdraw a sample from the well, transfer the sample from the bailer directly into the sample container.

3.7 Record sampling information in the field logbook. Label appropriate sampling containers with sampling details and custody information

3.8 Secure well.

3.9 Dispose of all sampling material and PPE as required by the Site Management Plan.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

None

7.0 Attachments

Field forms required for this activity have been attached to this SOP.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sample Type	Composite Yes or No	Sampling Method	Depth of Sample Top	Depth of Sample Bottom	Units	Sample Date	Sample Time	COC Date	Analyses	[illegible] Case Number	Date received [illegible]	Comments
LIF - Soil Intact Core Sample																	
Example																	
LIF-87	*LIF-87-10-13-2*			*SO*	*N*	*Y*	*Intact Core - Geoprobe*	*10*	*13*	*ft*	*1/27/2008*	*16.00*	*1/27/2008*	*Pore Fluid Saturation/ Core photography*			
LIF - Soil SPLP Leachability																	
Example																	
SB-39	*SB-39-07-09*			*SO*	*N*	*N*	*DPT*	*7*	*9*	*ft*	*2/28/2008*	*07 47*	*2/29/2007*	*SPLP for VOCs and SVOCs*			
Soil (Landfill Investigation):																	
Example																	
LTR-E-01	*LTR-E-01-2*	*BOFA7/MBODZ2*	*BOFA7*	*SO*	*N*	*N*	*Hand*	*9*	*10*	*ft*	*12/26/2007*	*13 29*	*12/26/2007*	*TCL-full, TAL-Metals*	*30708*		
Groundwater (Air/Bio Sparge Evaluation) Sample:																	
Example																	
TPZ-07	*TPZ-07-1-2*	*BOFA8*		*GW*	*N*	*N*	*Low Flow*				*12/16/2007*	*10 07*	*12/16/2007*	*TCL-VOCs*	*30942*		
TPZ-10	*TPZ-10-2-2*			*GW*	*N*	*N*	*Low Flow*				*12/16/2007*	*10 07*	*12/16/2007*	*Bacteria Count*			
LNAPL (Fluid Properties) Pair Sample:																	
Example																	
MW-03	*FP-MW-03-2*			*FP*	*N*	*N*	*Bailer*				*1/2/2007*	*14 07*	*1/2/2007*	*LNAPL Fluid Properties*			
MW-03	*GW-MW-03-2*			*GW*	*N*	*N*	*Bailer*				*1/2/2007*	*14.17*	*1/2/2007*	*LNAPL Fluid Properties*			
IDW (Decontamination Water):																	
Example																	
WW	*WW-01-02*	*BOEB9/MFOOV3*		*WW*	*N*	*N*	*Bailer*				*3/14/2008*	*13 50*	*3/14/2008*	*TCL-Full, TAL-Metals*	*30125*		
WW	*WW-01-02*			*WW*	*N*	*N*	*Bailer*				*3/14/2008*	*13 50*	*3/14/2008*	*Haz Waste Characteristics (ignitability, corrosivity, reactivity)*			
IDW (LNAPL):																	
Example																	
FP-IDW	*FP-IDW-01-02*			*FP*	*N*	*N*	*Bailer*				*3/15/2008*	*16 20*	*3/15/2008*	*TCLP and Haz Waste Characteristics (ignitability, corrosivity, reactivity)*			
Fire Hydrant Water Samples:																	
Example																	
FH	*FH-01-02*	*B0F18/ MB0D49*		*W*	*N*	*N*	*Hand*				*12/15/2007*	*08.12*	*12/17/2007*	*TCL-Full, TAL-Metals*	*30987*		
Equipment and Trip Blanks																	
Example																	
	F-1-11-03-07	*B0EN9/ MB0DS9*		*GW*	*EB*	*N*					*11/3/2007*	*09 55*	*11/5/2007*	*TCL-Full, TAL-Metals*	*29935*		
	T-1-11-03-07	*B0ER0*		*GW*	*TB*	*N*					*11/3/2007*	*09.50*	*11/5/2007*	*TCL VOC*	*29935*		

Legend:

SO	Soil sample	SD	Sediment	N	Normal media sample	TCL-full	Target compound list - volatile organic compounds, semi-volatile organic compounds, PCBs, pesticides	LNAPL	Light Non-Aqueous Phase Liquid
MS/MSD	Matrix spike and duplicate	FP	Free product	FD	Field duplicate	TCL SVOC	Target compound list - semi volatile organic compounds	TCLP	Toxicity Characteristic Leaching Procedure
SL	Sludge sample	FH	Fire hydrant	EB	Equipment blank	TAL Total Metals	Target analyte list for total metals		
GW	Groundwater sample	WW	Waste water	TB	Trip blank	VOC	Volatile Organic Compound		
SW	Surface water	IDW	Investigation Derived Waste	MSD	Matrix Spike/ Matrix Spike Duplicate	SVOC	Semi-Volatile Organic Compound		

Notes:
CLP numbers never use the letters: O, U, V, I
CLP does use numbers 1, 0

STANDARD OPERATING PROCEDURE
SAMPLING OF LIQUID IDW AND FIRE HYDRANT

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the procedure for collecting samples from IDW waste streams (decontamination water and LNAPL planned to be stored in drums) along with a sample of an off site water source (fire hydrant). All waste streams will be stored and identified in accordance to the Site Management Plan.

2.0 Materials

1. ¾" Teflon Lined Disposable Bailer
2. 100' of string
3. 8 mil Plastic Sheeting
4. Photoionization Detector
5. PPE: Nitrile Gloves and Eye Protection
6. Sample bottles (pre-preserved)
7. Sample tags, labels and chain of custody forms
8. Field logbook
9. Shipping containers (coolers with ice)

3.0 Procedures

<u>IDW Sampling - LNAPL and Decontamination Water:</u>

3.1 Prior to opening a drum, prepare sampling by placing protective plastic material around the drum to be sampled.

3.2 Upon opening a drum, screen the breathing zone with a calibrated PID.

3.3 Remove the plastic wrapping from the dedicated bailer and attach a bailer cord (braided nylon) to the bailer.

3.4 Lower the bailer slowly and gently into to the IDW drum. Once the bailer is completely full, carefully (avoiding contact with the sides of the drum) withdraw a sample from the well. Transfer the sample from the bailer directly into the sample container(s).

3.5 Record sampling information in the field logbook. Label appropriate sampling containers with sampling details and prepare custody documentation.

3.6 Secure lid back onto IDW drum.

3.7 Dispose of all sampling material and PPE as required by the Site

Management Plan

Fire Hydrant Sampling:

3.8 To document the quality of the water used for decontamination, one water sample will be collected directly from the fire hydrant located near the entrance of the site.

3.9 The hydrant will be opened and ran for a period of five minutes. After the water has purged for five minutes, a water sample will be collected directly from the fire hydrant.

3.10 Record sampling information in the field logbook. Label appropriate sampling containers with sampling details and prepare custody documentation.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

None

7.0 Attachments

None

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sample Type	Composite Yes or No	Sampling Method	Depth of Sample Top	Depth of Sample Bottom	Units	Sample Date	Sample Time	COC Date	Analyses	[illegible] Number	Date received validated [illegible]	Comments
LIF - Soil Intact Core Sample																	
Example																	
LIF-87	LIF-87-10-13-2			SO	N	Y	Intact Core - Geoprobe	10	13	ft	1/27/2008	16.00	1/27/2008	Pore Fluid Saturation/ Core photography			
LIF - Soil SPLP Leachability																	
Example																	
SB-39	SB-39-07-09			SO	N	N	D P T	7	9	ft	2/28/2008	07.47	2/29/2007	SPLP for VOCs and SVOCs			
Soil (Landfill Investigation):																	
Example																	
LTR-E-01	LTR-E-01-2	BOFA7/MBODZ2	BOFA7	SO	N	N	Hand	9	10	ft	12/26/2007	13.29	12/26/2007	TCL-full, TAL-Metals	30708		
Groundwater (Air/Bio Sparge Evaluation) Sample:																	
Example																	
TPZ-07	TPZ-07-1-2	BOFA8		GW	N	N	Low Flow				12/16/2007	10.07	12/16/2007	TCL-VOCs	30942		
TPZ-10	TPZ-10-2-2			GW	N	N	Low Flow				12/16/2007	10.07	12/16/2007	Bacteria Count			
LNAPL (Fluid Properties) Pair Sample:																	
Example																	
MW-03	FP-MW-03-2			FP	N	N	Bailer				1/2/2007	14.07	1/2/2007	LNAPL Fluid Properties			
MW-03	GW-MW-03-2			GW	N	N	Bailer				1/2/2007	14.17	1/2/2007	LNAPL Fluid Properties			
IDW (Decontamination Water):																	
Example																	
WW	WW-01-02	BOEB9/MFOOV3		WW	N	N	Bailer				3/14/2008	13.50	3/14/2008	TCL-Full, TAL-Metals	30125		
WW	WW-01-02			WW	N	N	Bailer				3/14/2008	13.50	3/14/2008	Haz Waste Characteristics (ignitability, corrosivity, reactivity)			
IDW (LNAPL):																	
Example																	
FP-IDW	FP-IDW-01-02			FP	N	N	Bailer				3/15/2008	16.20	3/15/2008	TCLP and Haz Waste Characteristics (ignitability, corrosivity, reactivity)			
Fire Hydrant Water Samples:																	
Example																	
FH	FH-01-02	B0F18/ MB0D49		W	N	N	Hand				12/15/2007	08.12	12/17/2007	TCL-Full, TAL-Metals	30987		
Equipment and Trip Blanks																	
Example																	
	F-1-11-03-07	B0EN9/ MB0DS9		GW	EB	N					11/3/2007	09.55	11/5/2007	TCL-Full, TAL-Metals	29935		
	T-1-11-03-07	B0ER0		GW	TB	N					11/3/2007	09.50	11/5/2007	TCL VOC	29935		

Legend:

SO	Soil sample	SD	Sediment	N	Normal media sample	TCL-full	Target compound list - volatile organic compounds, semi-volatile organic compounds, PCBs, pesticides	LNAPL	Light Non-Aqueous Phase Liquid
MS/MSD	Matrix spike and duplicate	FP	Free product	FD	Field duplicate	TCL SVOC	Target compound list - semi volatile organic compounds	TCLP	Toxicity Characteristic Leaching Procedure
SL	Sludge sample	FH	Fire hydrant	EB	Equipment blank	TAL Total Metals	Target analyte list for total metals		
GW	Groundwater sample	WW	Waste water	TB	Trip blank	VOC	Volatile Organic Compound		
SW	Surface water	IDW	Investigation Derived Waste	MSD	Matrix Spike/ Matrix Spike Duplicate	SVOC	Semi-Volatile Organic Compound		

Notes:
CLP numbers never use the letters: O, U, V, I
CLP does use numbers 1, 0

STANDARD OPERATING PROCEDURE
DATA MANAGEMENT PLAN

1.0 Scope and Application

Describe the database that will be used and how the data will be presented in a consistent manner during both the Phase 1 and 2 investigations.
The following are discussed:

Description of the data collected for the Diamond Head Site
- Historic data
- Data collected as part of the Phase 1 investigation
- Data collected as part of the Phase 2 investigation

Data management
- Data collected as part of the Phase 1 investigation
- Data collected as part of the Phase 2 investigation

2.0 Materials

None

3.0 Procedure

Description of the data collected for the Diamond Head Site

There are two sets of data that will require management and presentation: historic data and data from the Phase 1 and 2 investigations. The data will be imported into the same data base and all tables will be generated by listing the sampling locations in consecutive numerical order irrespective of whether the location was sampled previously or during the Phase 1 or 2 RIs.

<u>Historic data</u>
Historic data is available from both 1991 and 1999. We were not able to obtain any of the 1991 data – so the historic data consists only of 1999 data. The 1999 data consists of soil samples from soil borings, sediment samples, 4 groundwater samples collected directly from soil borings, and associated QA/QC samples. These data were entered into the database using a data entry template. GPS survey information is also available for this data.

The following issues were noted with the data.

- Missing the organics results for samples SS08, 09, 10, 11, and 12.
- The following information is not available and "unknown" was entered in the columns:

Analysis Date
Analysis Time
Prep_Date
Prep_Time
Leachate_Method
Leachate_Date
Leachate_Time
Method_Detection_Limit
Reporting_Detection_Limit

<u>Data collected as part of the Phase 1 investigation</u>
The following data was collected as part of the Phase 1 RI:
Soil boring logs
Well construction diagrams
Samples from:
Soil borings
Surface water
Sediment
Surface soil (one sample)
Groundwater
DI water (produced in NJO warehouse)
Tap water (from NJO warehouse)
Fresh water tank
Wastewater tank
Fire hydrant
Water levels (3 rounds)
Floating oil thickness measurements (3 rounds)
GPS survey information for the sampling locations (easting and northing and ground elevation
Surveyed site plan showing all sampling locations

Samples were tracked using a sample tracking sheet.

Note the following:

- Wells MW-8S and 16S were not installed as planned so there are no well construction diagrams for these wells.
- Piezometer PZ-13 was damaged so there will is no well construction diagram for this location.

<u>Data collected as part of the Phase 2 investigation</u>
The following data to be collected during the Phase 2 RI will be of a different nature than the Phase 1 data and not lending itself to importing into EquiS. Many of the results with be from physical tests on soil, groundwater and LNAPL samples. Therefore, only the data from the sampling of the soils in the landfill trenches and from the sampling of the temporary well points associated with the

pilot testing will be imported into EquiS. The remaining results will be maintained as Excel files. Other data that will be generated are:
Well construction diagrams for temporary piezometers
IDW results
Fire hydrant
Water levels and LNAPL thickness measurements (2 rounds)
GPS survey information for the sampling locations (easting and northing and ground elevation
Surveyed site plan showing all sampling locations

- Samples will be tracked using the same tracking sheet as used during Phase 1.

Data management

The following is a description of the data management performed during Phase 1 and to be performed during Phase 2:

- Import the 1999 and Phase 1 data into the project database. Note that from here on, the combined data set is referred to as the Phase 1 RI data.
- Import the landfill soil and groundwater data from the Phase 2 into the database.
- Maintain all other results in Excel format.

<u>Data collected as part of the Phase 1 investigation</u>

Logs and cross sections
- Print boring logs and well construction diagrams from the tools.
- Prepare geologic cross sections and fence diagrams.

Level maps
- Prepare water level maps for each of two formations for three events (six total) and floating product thickness maps for three events (three maps).

Maps of analytical results
- Prepare spider diagrams in CAD showing call out boxes with detected concentrations above standards in each medium at the site for each class of contaminants.
- Prepare plots showing isoconcentration contour maps of total concentrations of VOCs, SVOCs, and pesticides and PCBs in soil and groundwater.

Tables
Prepare tables as follows:
- Tables containing a printout of the entire database, with separate printouts for each media sampled: soil, groundwater, surface water, sediment, QA/QC

samples (EB,FB, TB), and other media sampled (DI water, tap water, fresh water tank, wastewater tank, and fire hydrant water).
- The following information will be included for each location: station, sample depth, CH2M HILL sample number, CLP sample number, and date sampled.
- Separate tables will be provided for each class of compounds (VOCs, SVOCs, pesticides, PCBs, and metals) in each of the sampled media. Non detect results will be shown as the detection levels followed by a "U". Note that tables for a medium will have the same list of sample stations (i.e., same list of borings will appear on all tables).
- The above tables will be generated a second time showing only detected concentrations (results with U, UJ, R or any other qualifier with a U and R will not be shown) and highlighting the concentrations exceeding standards/criteria.
- *Total detected concentrations* will also be calculated for each class of organics at each location (VOCs, SVOCs, pesticides, and PCBs). Note that tables for a medium will have the same list of sample stations (i.e., same list of borings) and the same sample information for each location as the tables in 1) above. The non-detected cells (those with results qualified with U-and R-related qualifiers) will be left blank, the standards or criteria used will be listed starting with the second column in the table, and the results exceeding the standards will be highlighted in light gray and a letter descriptor will show which standards were exceeded by a result.
- The standards / criteria that will be used include the Region IX PRGs, Federal and State MCLs, and NJDEP cleanup criteria.
- Statistics will be prepared for each of the sampled media: soil, surface water, sediment, and groundwater.

<u>Data collected as part of the Phase 2 investigation</u>

Logs and cross sections
- Print well construction diagrams from the tools.

Level maps
- Prepare water level maps for the formation above the peat layer for two events and floating product thickness maps for the same 2 events.

Landfill
- Prepare spider diagrams in CAD showing call out boxes with detected concentrations above standards in the trenches excavated in the landfill for each class of contaminants.
- Prepare a map of the trenches keyed in to photographs and to noteworthy observations documenting the contents of the landfill and any noted concerns.

LIF

Prepare diagrams showing the distribution (vertical and horizontal) of mobile and residual LNAPL at the site.

LNAPL recovery
Prepare maps showing the radius of influence achieved during the recovery test.

Tables
Prepare tables as follows:

- Tables containing a printout of the Phase 2 results, with separate printouts for each media sampled: soil, groundwater, LNAPL, QA/QC samples (EB,FB, TB), and other media sampled (IDW and fire hydrant water).
- The following information will be included for each location: station, sample depth, CH2M HILL sample number, CLP sample number, and date sampled.
- Separate tables will be provided for each class of compounds (VOCs, SVOCs, pesticides, PCBs, and metals) in each of the sampled media. Non detect results will be shown as the detection levels followed by a "U". Note that tables for a medium will have the same list of sample stations (i.e., same list of borings will appear on all tables).
- The above tables will be generated a second time showing only detected concentrations (results with U, UJ, R or any other qualifier with a U and R will not be shown) and highlighting the concentrations exceeding standards/criteria.
- The standards / criteria that will be used include the NJDEP cleanup criteria.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Sample results need to be carefully tracked and results reviewed to ensure that only data that meets the data quality objectives is used,

6.0 References

None

7.0 Attachments

None.

ATTACHMENT C

Updated
Health and Safety Plan
(HSP)
(submitted under separate cover)

ATTACHMENT D

Contractor Quality Control Plan (CQCP) (submitted under separate cover)